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A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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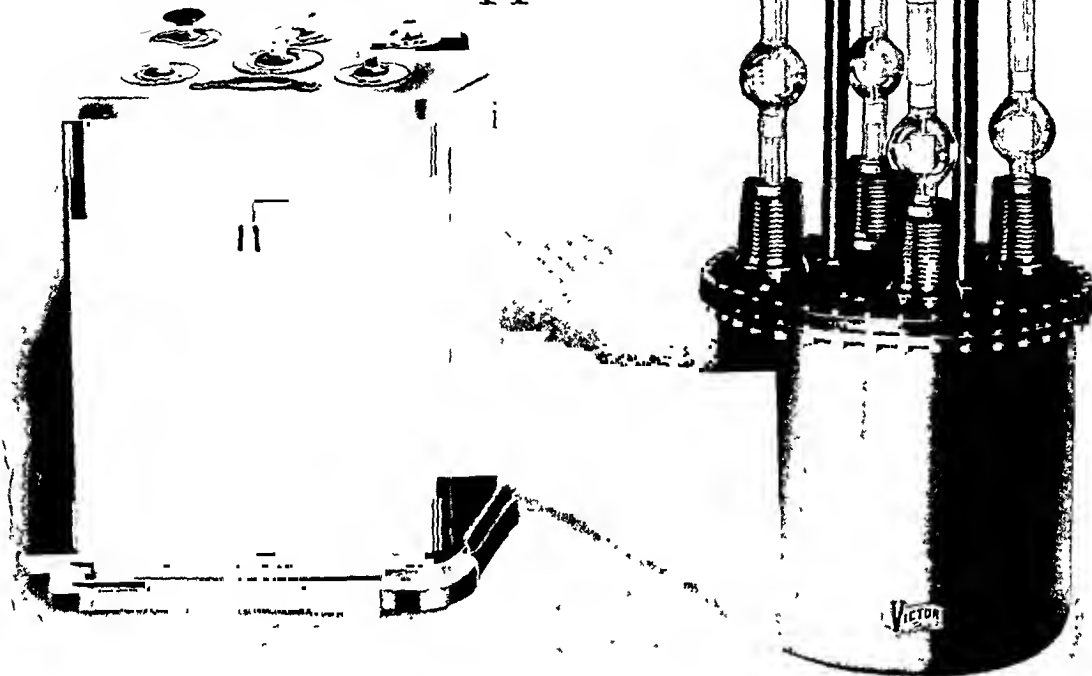
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No. 1

THE RELATIVE BIOLOGICAL EFFECTIVENESS OF X-RAYS AND GAMMA RAYS¹

By G. FAILLA, D.Sc., and P. S. HENSHAW, Ph.D.,
Biophysical Laboratory, Memorial Hospital, New York City

INTRODUCTION

THE effect of ionizing radiations in a living cell depends on three physical factors: (1) The *intensity* of the radiation at the cell (considered as a point); (2) the *time* during which the cell is exposed to the radiation, and (3) the *quality* of the radiation reaching the cell. Theoretically the biological effect should be influenced by changes in any one, any two, or all of the above factors. If this conclusion is to be tested experimentally, one must be able to measure the biological effect as well as the intensity, duration of exposure, and quality of the radiation. Furthermore, if it is desired to investigate the influence of only one of the three factors, it is essential that the other two be kept constant, and that all other conditions remain the same. This principle was strictly adhered to in the biological experiments to be described in the present paper, only the quality of radiation being changed.

"Biological effect" is a general expression which should be used with considerable care. Ionizing radiations are capable of producing an infinite number of biological effects. Any quantitative relationships which may be obtained experimentally refer only to the par-

ticular biological effect investigated, and are not necessarily true for all biological effects. For this reason our experiments were carried out with more than one biological material, and the observed effect, or "end point," was also different.

In attempting to determine the influence of one of the three physical factors on a particular biological effect, it is advantageous to vary the factor within the widest practical limits. It is then possible to detect differences which otherwise might be masked by experimental errors, which, unfortunately, are always of considerable magnitude in biological experiments. For this reason gamma rays, and X-rays produced at 165 K.V., with a filter of 2.04 mm. Cu, were used in our experiments. The quality factor in this case is very different, and yet no complications due to uneven distribution of radiation in the material are introduced.

In order to fulfill the requirement of equality of the other physical factors, it is necessary to base the measurements of the intensity of X-rays and gamma rays on some effect which both are capable of producing (other than the one under investigation). As such an effect, one might choose the blackening of a photographic plate, the change in a chemical compound, or even a biological change. But in view of the uni-

¹To be presented at the Third International Congress of Radiology, Paris, July, 1931.

versal adoption of air ionization as the effect by which X-rays are measured, it is desirable to use this effect for both qualities of radia-

X-rays in Roentgens.—The definition of the International Unit of X-radiation—the “roentgen,” or “r,”—imposes certain re-

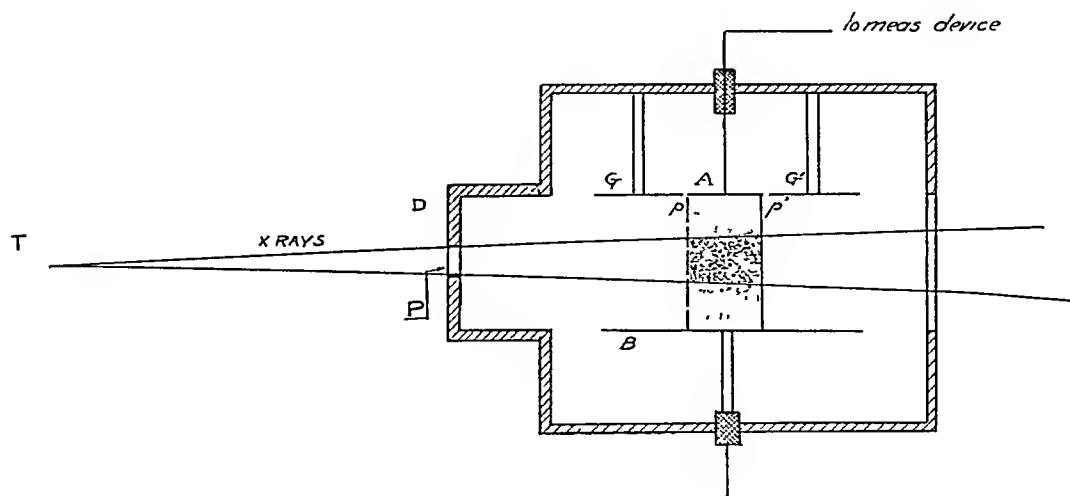


Fig. 1. Measurement of X-rays with standard ionization chamber.

tion. Furthermore, it is desirable to express the measurements in terms of the international unit of X-radiation.

The measurement of gamma rays in roentgens by direct means involves certain experimental difficulties which account for the fact that no data can be obtained from the literature. Kessler and Sluys (1) described, in 1929, an apparatus by which they were planning to make such measurements, but to date they have not published their results. Measurements by indirect means have been reported by many investigators (2-11). The results suffer from the limitations of the methods used, and, in addition, are quite discordant. In the present paper are incorporated the results of our direct measurement of gamma rays in roentgens. Since they differ considerably from any estimates previously reported, we shall describe the work in detail.

PART I (PHYSICAL)

1. Requirements for the Measurement of

requirements on the method and apparatus used for its experimental determination. The definition is as follows: “The International Unit of X-radiation is the quantity of X-radiation which, when the secondary electrons are fully utilized and the wall effect of the chamber is avoided, produces in one cubic centimeter of atmospheric air, at 0° C. and 76 cm. mercury pressure, such a degree of conductivity that one electrostatic unit of charge is measured at saturation current.” For the purpose of our discussion the principal requirements are: (1) that the secondary electrons must be fully utilized, and (2) that the wall effect of the chamber must be avoided.

Since the unit is based on a certain amount of ionization in one cubic centimeter of air, it follows that experimentally one must determine the ionization in a *known volume* of air. But, according to requirement (2) above, this volume cannot be bounded by walls. Hence it is necessary in practice to resort to indirect means for the determina-

tion of the volume of air the ionization of which is being measured.

The arrangement which is used now quite generally for this purpose is shown in Figure 1. In a lead-lined case are mounted by means of suitable insulators two parallel plate electrodes, A and B. Electrode A is short in comparison to B, but has two "guard" plates, G and G', situated in its plane but separated from it by narrow air spaces. The purpose of these plates is to insure a uniform electrostatic field between electrodes A and B, so that only ions produced between the imaginary planes p and p' are collected by electrode A. A diaphragm, D, at one end of the ionization chamber allows a narrow pencil of X-rays to pass between the electrodes and emerge at the other end of the chamber without striking the electrodes or any part of the enclosure.

With such an arrangement it is possible to measure the intensity of the X-ray beam at point P in terms of the roentgen. The measuring instrument connected to A determines the magnitude (in electrostatic units) of the electric current passing between electrodes A and B, due only to the ionization produced between the parallel planes p and p'. The diaphragm D determines the cross-section of the beam at P which produces this ionization. Since, in the case of ordinary X-rays, absorption by the air between P and p is negligible, the ionization current recorded by the instrument is the same as would be produced at P by the same beam in the air enclosed within an imaginary cylinder, having a base equal to the area of the diaphragm aperture and a height equal to the distance between planes p and p'. Both of these quantities can be measured directly, and, therefore, one can determine the virtual volume in which the ionization current was measured. Dividing then the value of the current in electrostatic units by the value of this volume in cubic centimeters, one gets the intensity of the

beam at point P in electrostatic units of current per cubic centimeter. Since the roentgen corresponds to one electrostatic unit of charge per cubic centimeter and 1 e.s.u. of current = 1 e.s.u. of charge per second, we can express the intensity of the beam in roentgens per second or roentgens per minute.

With an ionization chamber of the type described here, the requirement of "complete utilization of the secondary electrons" is met by the proper spacing of the electrodes A and B. X-rays passing between these electrodes liberate high speed electrons in the air which travel in all directions. These, in turn, ionize air. If the electrodes are close together some of the electrons will impinge on the plates before their energy has been utilized fully in the process of ionizing air. Electrons liberated by 200 K.V. X-rays may travel more than 80 cm. through atmospheric air. Accordingly the theoretical spacing for the electrodes in a chamber intended for measurements of these X-rays should allow this distance between the periphery of the radiation beam and the electrodes. However, the electrons follow a zigzag path through the air, and, while the actual distance travelled may be large, they do not get very far from the confines of the beam. It is found experimentally that little is gained by placing the electrodes at a greater distance than a few centimeters from the periphery of the beam.

In the above discussion we have assumed tacitly that the beam to be measured originated from a "point source." Let us consider now the case of a distributed source, which is really what one has to deal with in practice.

Every point of the source S, in Figure 2, sends a beam of radiation to the diaphragm, D, so that the resultant beam entering the chamber has the outline shown in the figure. In this case, also, the area of the diaphragm aperture and the width of the col-

lecting electrode A determine the volume in which the ionization current is measured. It should be noted that in this case the spacing between the electrodes must be considerably larger because the beam inside the

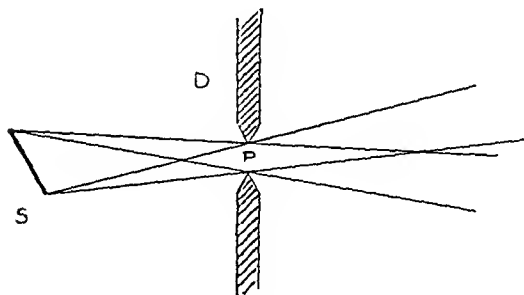


Fig. 2. Distributed source of radiation and sharp-edged diaphragm.

chamber is more divergent than in the case of the point source. But aside from this, the intensity of radiation at point P can be determined in roentgens per minute in the same manner, whether we have a point or a distributed source.

It is very important to note, however, that the diaphragm in Figure 2 is beveled to a sharp edge, and that this sharp edge forms the limits of the aperture and determines the cross-section of the beam at this point. If the diaphragm is thick and the aperture cylindrical, as shown in Figure 3, its cross-section is not effective for all points of the source S. For instance, the beam emanating from point *c* which enters the chamber (the cross-hatched portion in Figure 3) has a smaller cross-section than the beam originating at *c*. This, of course, is an exaggerated condition which does not obtain in the usual X-ray measurements. With the X-rays and distributed sources encountered in practice it is not necessary to use a very thick diaphragm and the aperture can be tapered sufficiently to avoid the complications illustrated in Figure 3, without introducing an appreciable error in the cross-section

of the beam due to the rays which are capable of passing through the thinner parts of the diaphragm edge.

On the other hand, when one attempts to use a chamber of this sort to measure radia-

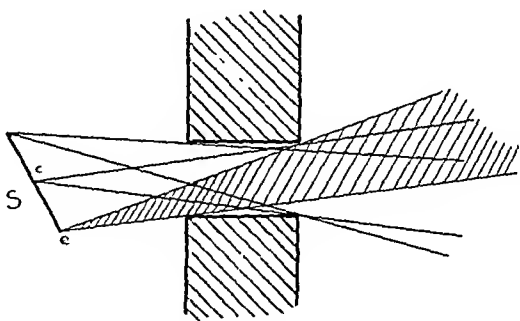


Fig. 3. Influence of the thickness of the diaphragm on the beam of radiation from a distributed source.

tion emitted by a distributed source capable of passing through several centimeters of lead, the design of a suitable diaphragm presents a very difficult problem. This is particularly true in the measurement of gamma rays on account of the fact that the limited amount of radium available precludes the placing of the source at a great distance from the ionization chamber.

2. *Provision of a Well-defined Gamma-ray Beam.*—From the preceding discussion it is evident that in order to measure gamma rays by means of an "open air" ionization chamber, it is necessary in the first place to devise some means for producing a well-defined beam of radiation, the cross-section of which at a given point can be determined accurately. The scheme which we decided to use is illustrated in Figure 4. A is a lead cylinder 30 cm. in diameter and 36 cm. high. It has a cylindrical hole in the center 3.9 cm. in diameter and 23.5 cm. deep. Into this hole may be lowered any one of the lead plugs L (already in position), M, S, or B. The first three of these have conical holes

as shown in cross-section, while B is solid throughout, except for a small hole at the bottom. Plugs L, M, and S were made by pouring molten lead into thin brass tubes in which conical cores of the desired dimen-

in diameter was drilled along the axis of the fiber plug.

As a source of gamma rays, radon was used. It was collected in thin-walled capillary glass tubes 12 to 14 mm. long and of

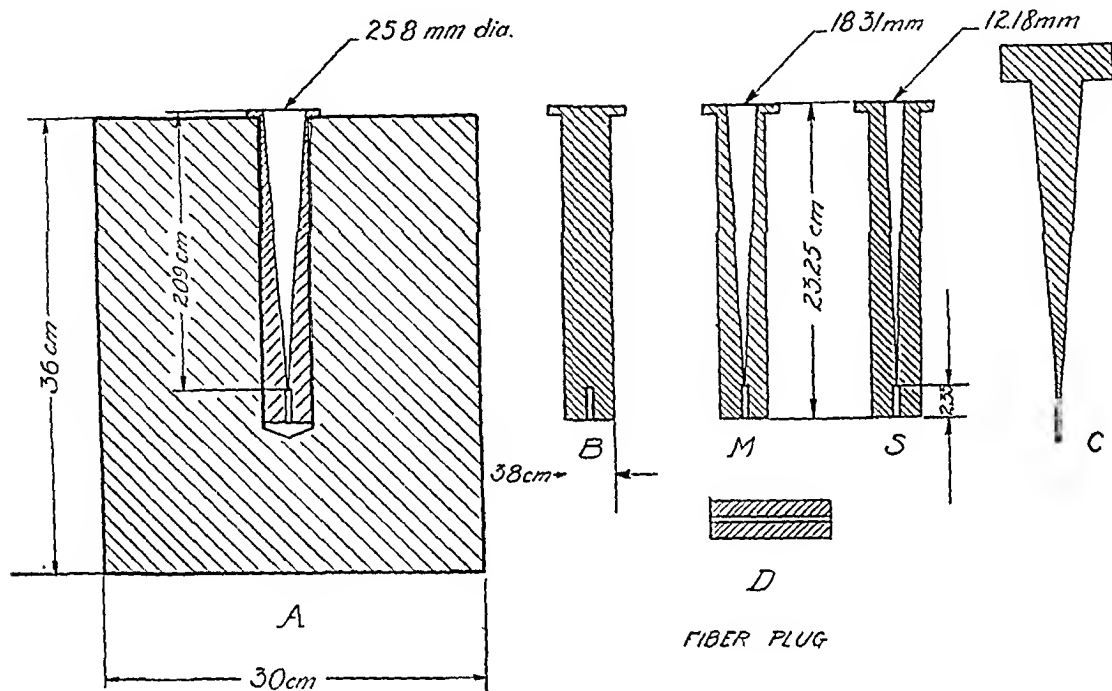


Fig. 4. Lead block and cones used to provide well defined beams of gamma rays.

sions had been fitted accurately. One of these cores is shown at C in Figure 4. Particular care was exercised in their construction to make sure that they were conical and coaxial with the brass tubes into which they were fitted. The castings obtained had smooth conical holes, with base diameters of 25.8, 18.31, and 12.18 mm., respectively. At the bottom end of each plug a cylindrical hole 6.3 mm. in diameter and 23 mm. deep was drilled. This hole truncates the cones at a depth of 21 cm. from the base, where the diameter is 4 millimeters. A paper fiber plug, D, was made to fit into the bottom receptacle of each lead plug. A hole 1.5 mm.

such diameter as would permit the use of three such tubes in the bore of the fiber plug D. One or more of these tubes was placed at one end of plug D, being held in place by a wooden pin inserted into the bottom part of the hole. A brass disc, 2 mm. thick, was made to fit the bottom receptacles in plugs L, M, S, and B, and act as a filter. The large cone, plug L, with the radon tube and brass filter in their proper proportions is shown in the large lead block, A. It should be noted that the geometrical relation of the truncated cone and the radon tube is such that every point of the radiating source is "visible" through the cone: that

is, the geometrical apex of the cone falls beyond the far end of the radon tube.

By using this arrangement we were able to obtain well defined beams of gamma rays. The degree of definition may be judged from

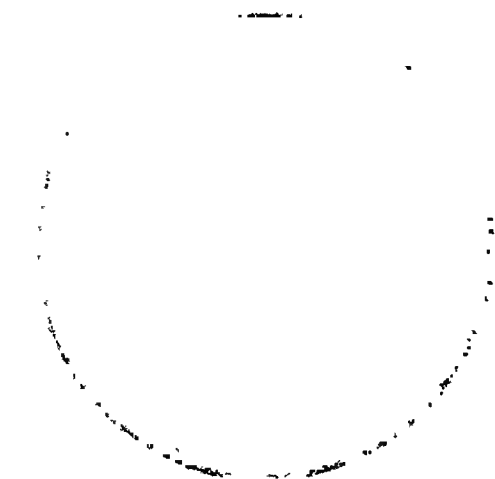


Fig. 5. Positive of autophotograph of gamma-ray beam from large cone. Film placed 85 cm. from source.

Figure 5. It shows a "positive" of the effect of the gamma-ray beam on a photographic plate placed at a distance of 85 cm. from the base of the large cone, L, in the lead block, A.

The reason for using in the experiment three cones of different solid angles will be evident from the following discussion. In practice it is impossible to have a *point* source of radiation. With our arrangement of the source in the cones we approach this ideal condition; but, nevertheless, certain rays are emitted at a small angle to the surface of the cone, giving rise to a penumbra around the "geometrical" beam. With our cones the penumbra effect would be a function of the periphery of the conical base, therefore, it would be a different proportion of the total beam with conical beams of different solid angle. Furthermore, one must consider also the effect of secondary and

scattered rays emerging from the lead walls of the cones. With cones of three different apertures it is possible to estimate the relative importance of the combined effect of penumbra and scattered radiation. The solid lead plug, B, permitted us to test for any radiation which might emerge from the lead block, A, since it is known that some gamma rays are capable of traversing more than 20 cm. of lead. (The lead thickness in our case was 20.9 cm. and it was found that the radiation transmitted was negligible.)

3. *Ionization Chamber and Measuring Instrument.*—Our large ionization chamber used for "standard" X-ray measurements was also used for the gamma-ray measurements. It was described in detail some time ago (12) and is shown diagrammatically in the upper part of Figure 6. It will be remembered that this is a large chamber with two parallel plate electrodes 22×42 centimeters. The plates are mounted on screws and the spacing can be varied at will from 4.6 to 24 centimeters. One electrode is made up of 11 aluminum strips 3.8×22 cm., arranged in the same plane and separated from one another by air gaps of 0.25 millimeter. Each strip is supported by separate amber insulators and can be used as an electrode independently of, or in combination with, any others. Thus the relative sizes of the "collecting" or master electrode and its guard plates may be varied at will. For the gamma-ray measurements the ionization chamber was mounted vertically above the lead cylinder, as shown in Figure 6. The center of the chamber was at a distance of 60 cm. from the radon tube. The beam of radiation produced by the large cone passed through the chamber without striking any part thereof. (The electrode spacing shown in the figure is 15 centimeters.) Batteries were used to provide the voltage for the chamber, and it was found that 1,000 volts was well above the saturation value for the radiation beams we used.

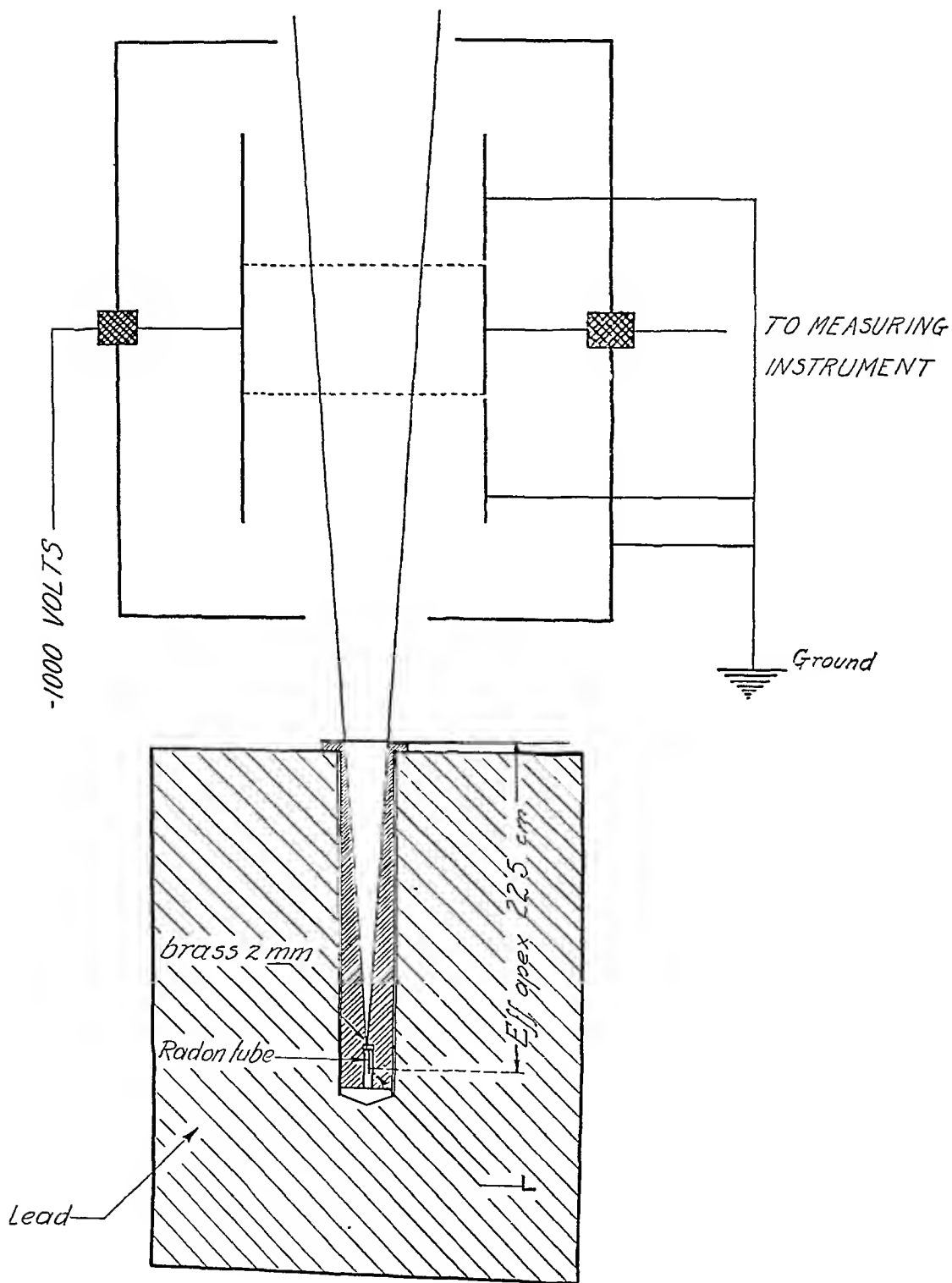


Fig 6 Set-up for the measurement of gamma rays in terms of roentgens

The ionization current was measured by means of the vacuum tube device previously described (13). In this case, however, it was found necessary to use either a two-stage amplifier with screen grid tubes, or a

up of a brass cylinder 8.3 cm. in diameter and 8.3 cm. high, at one end of which is a brass "neck" supporting the inner electrode, E, by suitable insulators and a guard ring, as shown. The main insulation is pro-

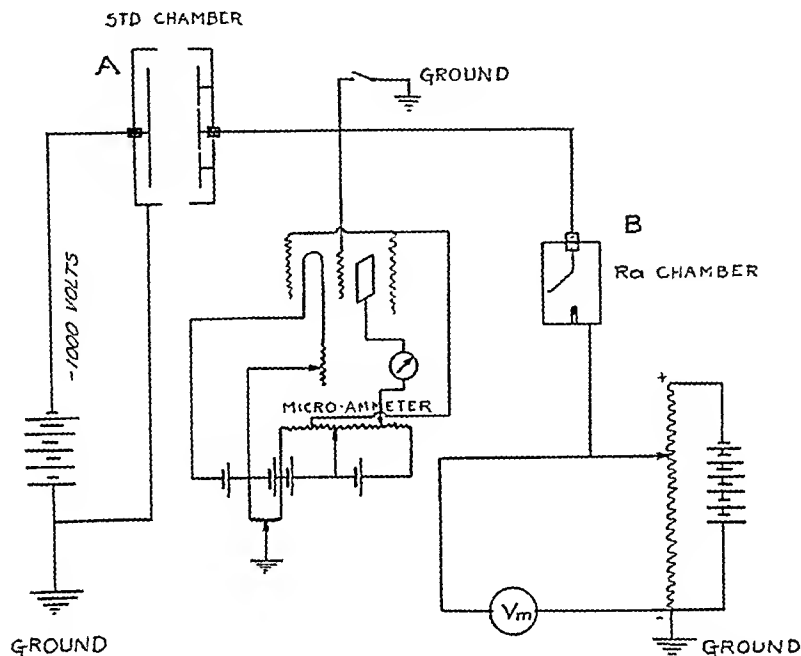


Fig. 7. Diagram of vacuum tube instrument used to measure the ionization current.

single special vacuum tube.¹ Most of the measurements were made with the latter tube, which is capable of detecting extremely small currents. The circuit of the measuring device is shown in Figure 7. It will be noted that the vacuum tube is used only as a detector of balance between the current produced in the standard chamber, A, and the radium chamber, B. Accordingly the readings are independent of the characteristics of the vacuum tube.

Since the radium chamber, B, is the most important part of the measuring device, it may be well to describe it in detail. Its construction is shown in Figure 8. It is made

provided by amber. Since during operation electrode E is always practically at ground potential, there is no possibility of current leakage. At the other end of the brass cylinder is provided a receptacle for a small glass tube containing 1.5 mg. of radium. The radium salt in this tube fills practically the whole space and the tube is attached to the metal receptacle by means of De Khotinsky cement. In this way the radio-active source is in a fixed position with regard to the chamber. The ionization produced in the air of the chamber is largely due to the beta rays emitted by the radium source.

By applying a certain voltage to the outer electrode of this chamber an ionization current is produced which may be used to com-

¹This is now known as Vacuum Tube FP-54.

pensate the current to be measured. With any given chamber and radium tube, the current depends only on the applied voltage. (If the chamber is not sealed air-tight a correction for pressure and temperature of the

be obtained conveniently. It is for this reason that the inner electrode, E, of the chamber was curved in the shape shown, the object of the curvature being to concentrate the electrostatic field at a point some distance

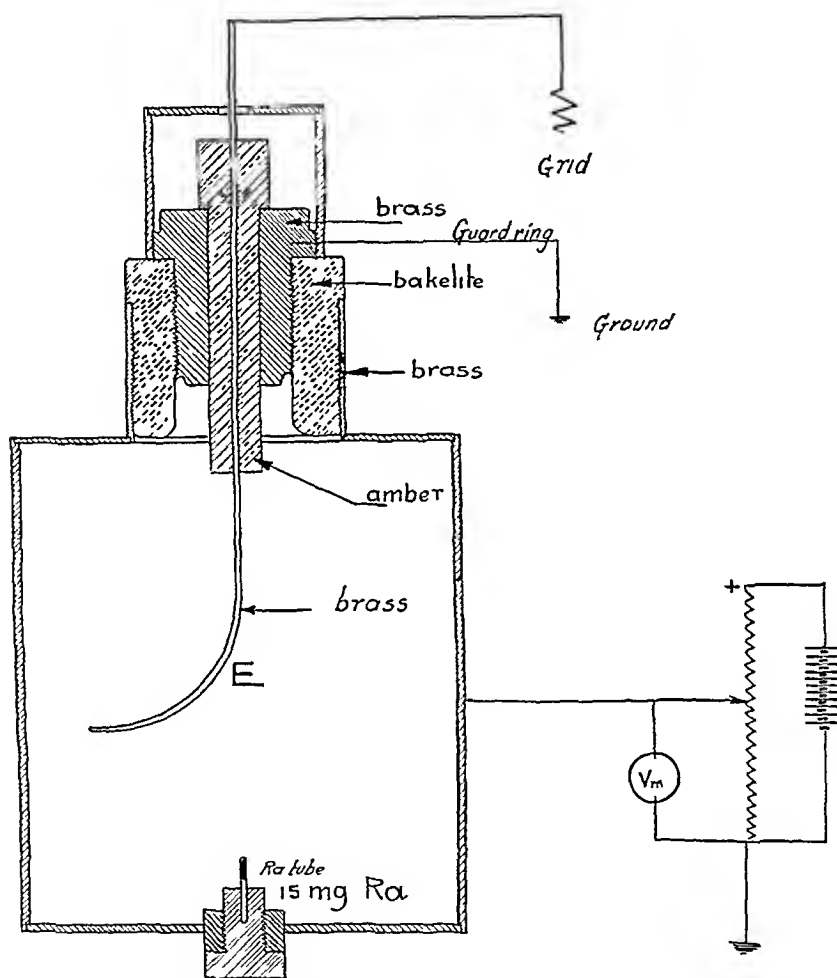


Fig. 8 Design of radium compensating chamber.

atmosphere must be made) It is thus possible to calibrate a chamber of this type so that, knowing the value of the voltage applied, one knows the magnitude of the current produced. Theoretically it makes no difference what the mathematical relation between the voltage and current is, but in practice it is desirable to have as nearly a straight line relation between the two as can

away from the radium tube, in the immediate vicinity of which the maximum ionization is produced. With this arrangement a much higher voltage is required for saturation and the relation between applied voltage and current is nearly linear, over a considerable voltage range. This may be seen from Figure 9.

At this point it may be well to mention the

provisions made for shielding of the measuring apparatus. Referring to Figure 6 again, it will be seen that the radon tube used as a source of gamma rays was essentially in the center of the large lead cylinder;

radium. The amount of radiation scattered back from the ceiling into the chamber or instrument was found by actual test to be negligible. Accordingly no additional lead shielding of the apparatus was necessary.

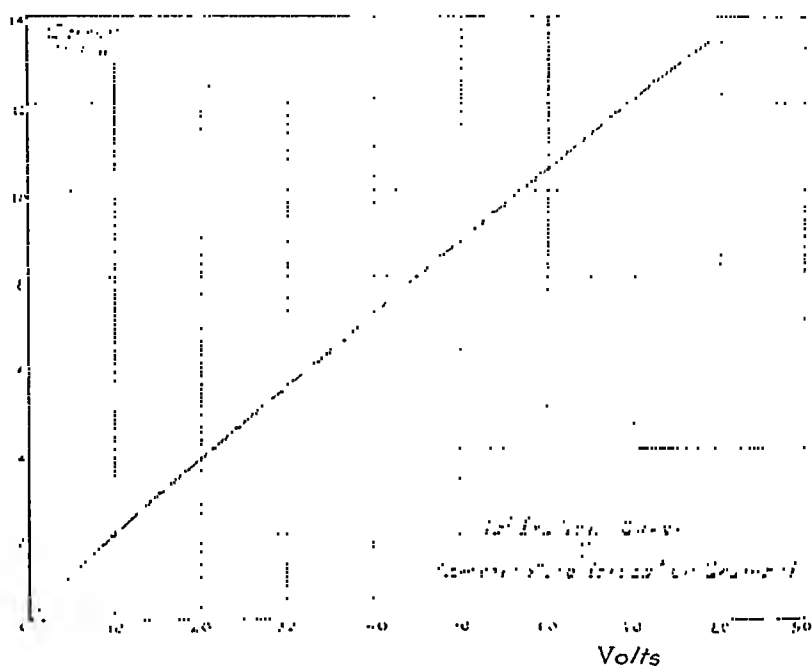


Fig. 9. Calibration curve of compensating chamber.

accordingly any "stray" radiation from the source would have to traverse about 18 cm. of lead. Furthermore, the measuring instrument was placed at a distance of about 160 cm. from the ionization chamber (and the radon tube). This provided sufficient screening for the instrument with its radium chamber. The solid lead plug of Figure 4 enabled us to test this point as well as the effect on the standard chamber of the "global" radiation through 20.9 cm. of lead. Both were found to be negligible. The useful gamma-ray beam was projected upwards, passing through the ionization chamber without striking it, and finally impinging on the ceiling of the room, 300 cm. above the

The electrical system, however, being very sensitive, had to be shielded electrically with some care.

4. *Calibration.*—It will be remembered from the discussion of Section 1 that the current through the standard ionization chamber must be known in electrostatic units in order to determine the intensity of the radiation beam in roentgens per minute. With our method of measurement it is necessary only to calibrate the radium compensating chamber (Fig. 8) in electrostatic units. An important advantage of the design of compensating chamber shown is that the calibration, once made, remains constant. However, on account of the small current

values involved, special precautions must be taken when the calibration is determined. For this reason the experimental procedure

dium in one upon the others. The radium tube of chamber B can be removed and replaced in the *same position* at any time.

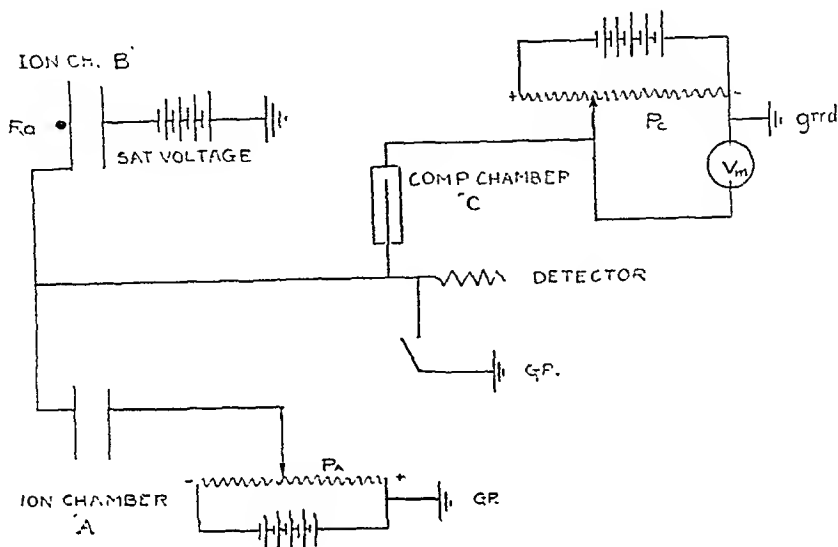


Fig. 10. Diagram of method used for the determination of the calibration curve.

employed will be described somewhat in detail.

The *shape* of the calibration curve of Figure 9 was determined as follows.² In Figure 10 there are three ionization chambers connected to the balance detector (grid of vacuum tube) of the measuring instrument. One of these chambers, C, is the compensating chamber to be calibrated. Chamber A is similar to C (for convenience) and is provided with a potentiometer, P_A , so that the current through it may be varied at will by adjusting the voltage applied to it. Chamber B is any suitable ionization chamber which, in conjunction with a radium tube, R_a , produces a saturation current which is small in comparison to the maximum current for which C is to be calibrated. The three ionization chambers are far enough apart, or are properly screened by lead, to avoid any appreciable influence of the ra-

With no voltage applied to chambers A and C, and no radium on chamber B, the zero reading of the instrument is taken. The radium tube is now placed in chamber B and the system is balanced by applying a certain voltage to chamber C. The current through both of these chambers is the same, but its magnitude is unknown. We know, however, and we record, the voltage which had to be applied to chamber C in order to establish balance in the system. We now remove the radium from chamber B and restore the balance by applying a certain voltage to chamber A, *without disturbing C*. The current through chambers A and C is the same, but no current flows through B since the radium tube has been removed. The electrical system is properly balanced and can be used as if no current flowed through the chambers A and C. By replacing the radium upon chamber B we produce in it the same current as before, although its magnitude is still unknown. Balance may

²This method was devised by Mr. Marinelli, of our laboratory.

provisions made for shielding of the measuring apparatus. Referring to Figure 6 again, it will be seen that the radon tube used as a source of gamma rays was essentially in the center of the large lead cylinder;

radium. The amount of radiation scattered back from the ceiling into the chamber or instrument was found by actual test to be negligible. Accordingly no additional lead shielding of the apparatus was necessary.

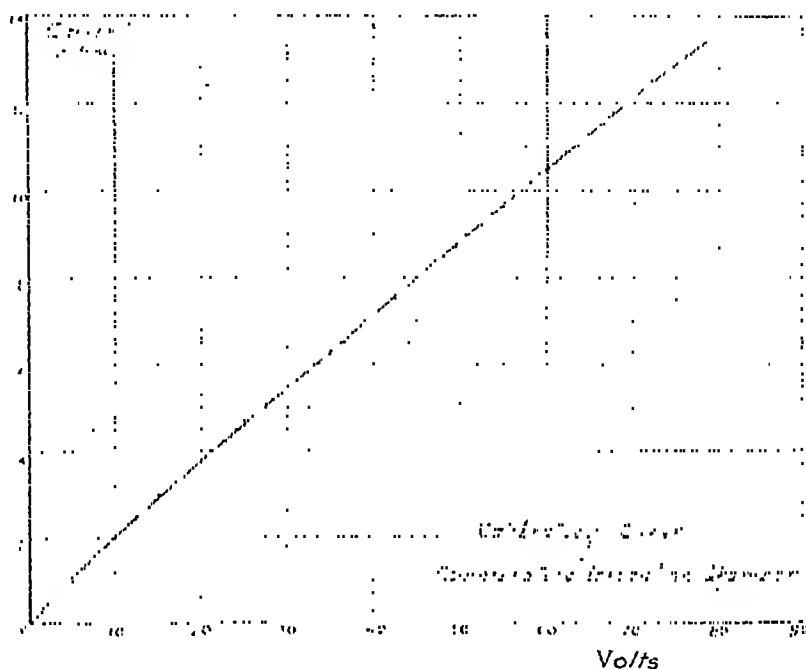


Fig. 9. Calibration curve of compensating chamber.

accordingly any "stray" radiation from the source would have to traverse about 18 cm. of lead. Furthermore, the measuring instrument was placed at a distance of about 160 cm. from the ionization chamber (and the radon tube). This provided sufficient screening for the instrument with its radium chamber. The solid lead plug of Figure 4 enabled us to test this point as well as the effect on the standard chamber of the "global" radiation through 20.9 cm. of lead. Both were found to be negligible. The useful gamma-ray beam was projected upwards, passing through the ionization chamber without striking it, and finally impinging on the ceiling of the room, 300 cm. above the

The electrical system, however, being very sensitive, had to be shielded electrically with some care.

4. *Calibration.*—It will be remembered from the discussion of Section 1 that the current through the standard ionization chamber must be known in electrostatic units in order to determine the intensity of the radiation beam in roentgens per minute. With our method of measurement it is necessary only to calibrate the radium compensating chamber (Fig. 8) in electrostatic units. An important advantage of the design of compensating chamber shown is that the calibration, once made, remains constant. However, on account of the small current

gives the *shape* of the calibration curve. It is necessary now only to determine the absolute value of the current for *any one point* on the curve and the arbitrary scale can be translated immediately into the desired current units.

Before describing this part of the calibration procedure, it might be well to point out certain advantages of the scheme just described. It is evident that the current increments may be made as small as desired, thus determining a large number of points through which the curve is finally drawn. This can be done most easily by choosing a radium tube of some suitable strength and adjusting the thickness of lead filter to control further the ionization in chamber B. Furthermore, the sensitivity of the measuring device is the same at each step; hence the shape of the curve can be determined in a simple manner with any degree of precision desired. Only one tube of small radium content (a few milligrams) is required for this purpose. (Since in our laboratory we have always available radon tubes ranging from 5 to 250 millicuries, the shape of the curve can be determined easily by omitting chamber A in Figure 10 and placing successively upon chamber B radon tubes of increasing strength. The ionization current will be proportional to the millicurie value of each tube, and the relation between voltage applied to chamber C and millicuries on B will give the *shape* of the calibration curve. This is the method employed at first.)

The current for which our radium compensating chamber was designed is of the order of one electrostatic unit, too small to measure with the highest sensitivity galvanometer available, yet it is of great advantage to use a galvanometer for the determination of the absolute value of the current. For this reason we used the following scheme to overcome the difficulty. We constructed an ionization chamber as shown at A in

Figure 11. It consists essentially of two coaxial cylindrical electrodes, M and N, suitably insulated. A brass tube, K, is supported

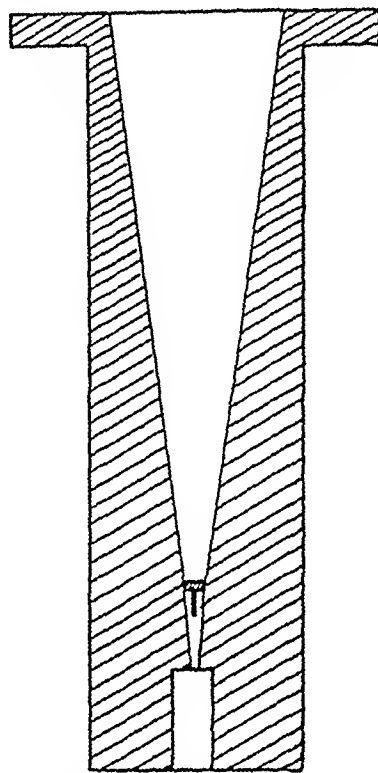


Fig. 12. Test for the "visibility" of the gamma-ray source through a lead cone.

along the axis of the chamber so that a rod, R, can be inserted into it at any time. This rod has a receptacle just large enough to house a tube of 50 mg. of radium. When the rod is slid into the tube, K, the hole, H, registers with pin, P, in the ionization chamber. In this way the radium tube is brought always to the same depth and has the same orientation in the ionization chamber. (The radium tube is kept permanently in rod, R.) The volume of the chamber is such that the saturation current produced by 50 mg. of radium can be measured easily with a Leeds and Northrup high sensitivity galvanometer. Other rods similar to R have been provided with radium tubes of 1, 5, and 10 mg., respectively. If the tubes were all identical in size and filtration, it is evident that the ioni-

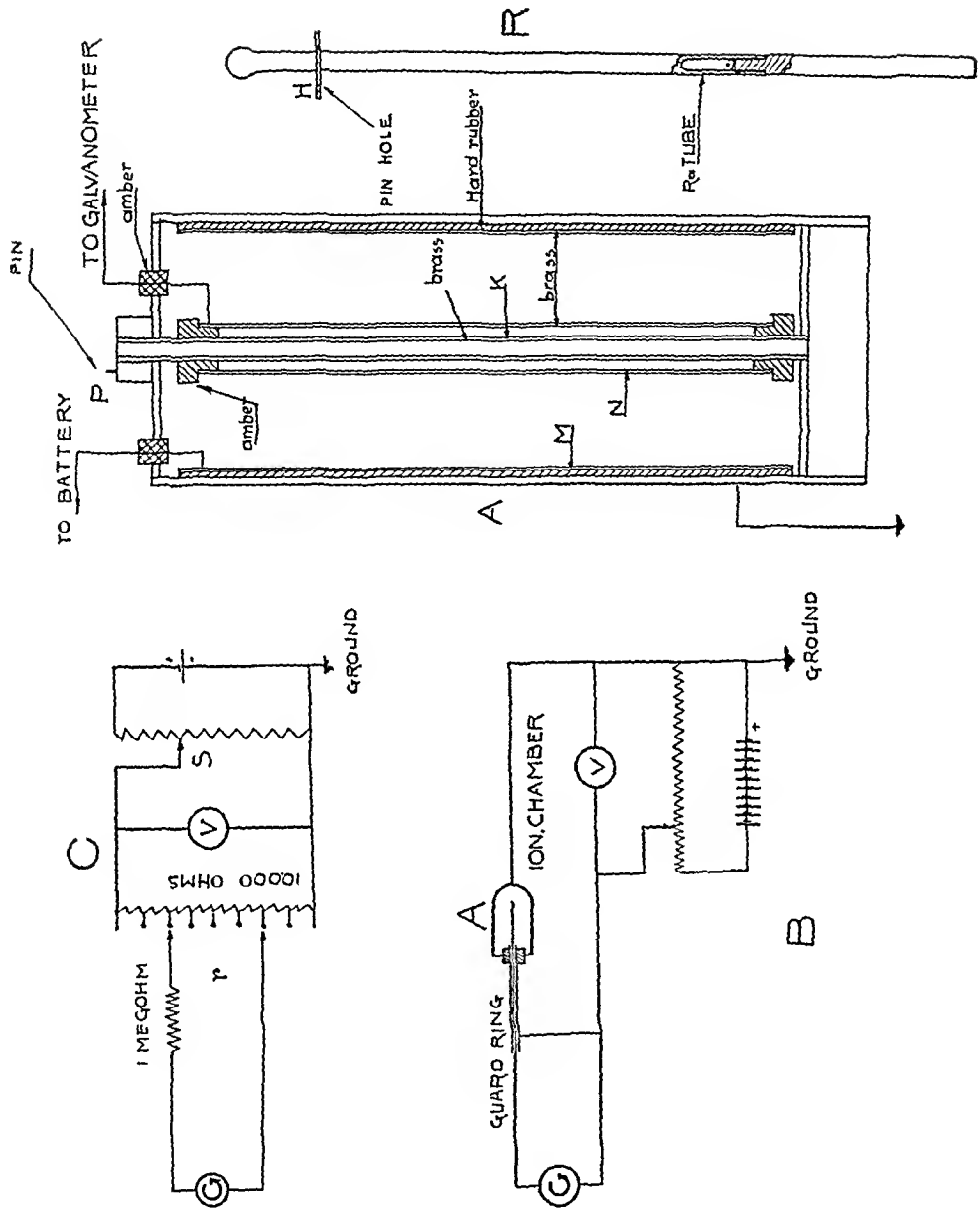


Fig. 11. Diagram of method used for the calibration of the compensating chamber in electrostatic units.

be re-established by increasing the voltage on C. When this has been done, the current passing through C is exactly twice the current produced in B by the radium tube. We know, therefore, what increase in the voltage applied to C is necessary to double the current through it. By repeating the procedure just described, one can determine the

voltage to be applied to C in order to produce any multiple of the constant (but unknown) current of chamber B with the given radium tube in place. Therefore, we can establish the relation between applied voltage and current for the compensating chamber C in equal current increments without knowing the actual magnitude of the current. This

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zation currents produced by them would be in proportion to their radium content. Hence, having measured the current in the case of the 50 mg. tube, the current produced

of Figure 11, with the radon tube in place, was connected to the measuring instrument and its current was balanced in the usual way by the radium compensating chamber.

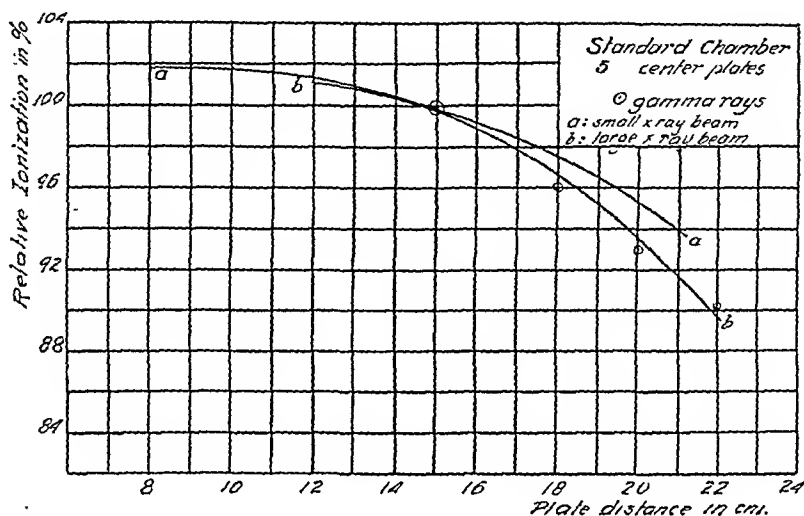


Fig. 13. Influence of field distortion in the standard chamber.

by the 1 mg. tube would be just one-fiftieth that of the former.

Since the tubes differ considerably in construction, this could not be done without applying the necessary corrections. In our case, it was simpler to place in a rod, similar to R, a tube containing about 50 millicuries of radon (the exact amount need not be known) and to use this source to produce the ionization current to be measured with the galvanometer. Since the disintegration rate of radon is accurately known (16.4 per cent in 24 hours), the current which the same tube would produce at any subsequent time can be calculated easily. Thus by making measurements at the proper time intervals it is possible to cover the current range from the initial value to zero, by using the same geometrical source. In our case the radon had to decay to about 5 mc. before the current reached the range of our compensating chamber. After this, the chamber

The magnitude of the current was calculated from the initial value and the elapsed time. This was repeated several times until the current became too small to balance properly. It is interesting to note that the points obtained in this way from day to day coincided almost exactly with the curve previously determined by a different method.

A substitution method was used to determine the magnitude of the current registered by the galvanometer. First, the galvanometer was connected in series with the ionization chamber A (see B, Fig. 11), containing the radon tube. The current flowing through the system produced a certain deflection (about 11 cm.), which was carefully noted. The galvanometer was then connected to the circuit shown at C of Figure 11, and the slider, S, was adjusted until the same galvanometer deflection as before was obtained. The reading of the voltmeter, V, and the values of the resistances in paral-

and in series with the galvanometer, determine the magnitude of the current through the galvanometer. Several such determinations were made at intervals during a period in which the radon tube produced large enough current to be measured by the galvanometer. In every case after the first measurement a close agreement was found between the new reading and the one calculated from the decay rate of radon.

Great care was exercised in making the connections of circuit C of Figure 11, to avoid leakage currents. The resistances involved in the calculation of the current were known accurately. The voltmeter, V, was calibrated against a standard cell by means of a Leeds and Northrup potentiometer. Thus in spite of the several steps in the process of determining the calibration curve of our radium compensating chamber, we can say that its accuracy is considerably higher than is required in work of this sort. A recent comparison of the same radium chamber with the measuring system used at the Bureau of Standards shows an agreement within 1 per cent throughout the useful range of the curve.

5. *Measurement of Gamma Rays in Roentgens.*—With the ionization chamber placed above the lead cylinder in the relative position shown in Figure 6, and about 800 mc. of radon in one of the cones, preliminary tests were made. From these it was evident that the spacing of the electrodes should be about 15 centimeters. It was found also that the collecting electrode of the chamber had to be quite wide in order to get a current which could be properly balanced by our radium compensating chamber. It will be remembered from the construction of our standard chamber that the collecting electrode is made up of parallel strips which can be connected together. In subsequent experiments, therefore, three or more of these strips were used, making the width of the electrode 11.48 or more centimeters.

In view of the small diameter of the cones directly over the gamma-ray source and the length of the radon tube, it was thought desirable to test experimentally whether every point of the source was within the geometrical prolongation of the cone to its apex. This was done by taking readings with the radon tube in its normal position and in the position shown in Figure 12. For this purpose the capillary glass tube was attached at one end to the brass filter, which was then lowered into the cone. Readings taken with the source in this position were higher than those obtained with the tube in the fiber cylinder below the small end of the cone, but the increase was substantially as calculated by the inverse square law, for a source closer to the aperture of the conical diaphragm.

Measurements were made at intervals extending over a period of several months. The results obtained were always very different from those reported in the literature (obtained by indirect means), no matter what modifications and allowances were made. The experimental results are given in Table I. Each group represents measurements made at one time. The last ones were made with the greatest care, and are, therefore, the most reliable ones. It is interesting to note that in spite of appreciable variations in the preceding results, the average is very close to the last ones. The gamma-ray emission under the geometrical conditions of the experiment and with a filter of 2 mm. of brass, is 0.00108 electrostatic unit per cubic centimeter per gram of radium. Since in the definition of the roentgen a temperature of 0° C. is specified, and our measurements were made at room temperature of approximately 22° C., it is necessary to take this into account in calculating the emission in roentgens per minute. The correction factor is $\frac{295}{273} = 1.08$, or 8 per cent. Therefore,

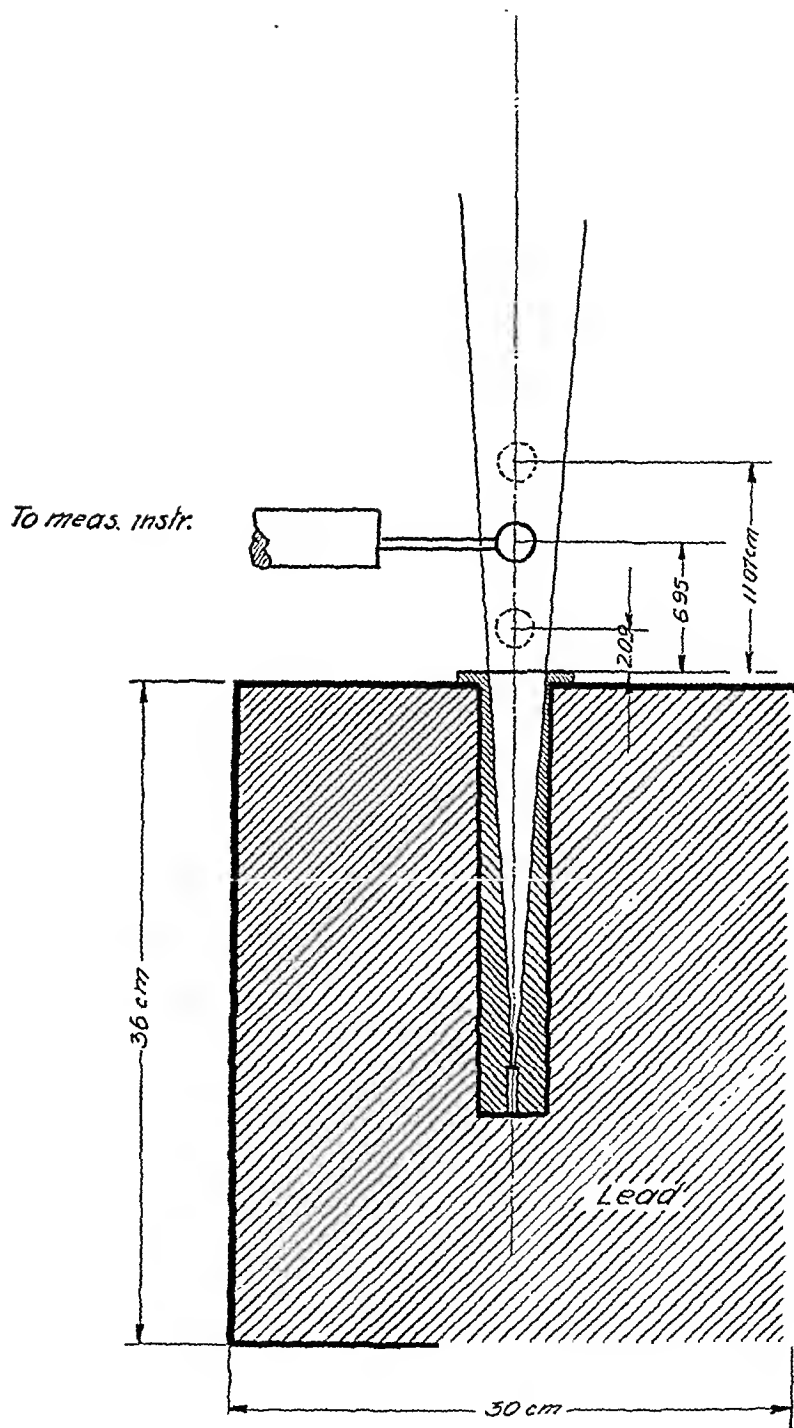


Fig. 14. Set-up for calibration of spherical lead chamber.

TABLE I

MEASUREMENT OF GAMMA RAYS WITH STANDARD CHAMBER

Cone	Ionization chamber setting		Volume (c.c.)	Current (c.s.u.)	Strength of source (mc.)	Electrostatic unit per c.c. per gram Ra
	Distance of electrodes (cm.)	Width of collector (cm.)				
Large	10	4.93	25.8	0.0227	807	0.00109
Large	15	19.13	100.0	0.0696	612	0.00113
Large	15	11.48	60.0	0.0401	612	0.00109
Medium	15	11.48	30.3	0.0197	612	0.00107
Small	15	11.48	13.3	0.0091	612	0.00112
Large	10	19.13	100.0	0.0772	711	0.00108
Large	10	11.48	60.0	0.0454	711	0.00108
Large	15	11.48	60.0	0.0467	695	0.00112
Medium	15	11.48	30.3	0.0217	695	0.00103
Small	15	11.48	13.3	0.0095	695	0.00103
Large	15	26.78	140.0	0.1190	736	0.00115
Medium	15	26.78	70.7	0.0540	736	0.00104
Small	15	26.78	31.3	0.0233	736	0.00101
Large	15	11.48	60.0	0.0552	808	0.00114
Medium	15	11.48	30.3	0.0258	808	0.00105
Small	15	11.48	13.3	0.0114	808	0.00106
Large	15	19.13	100.0	0.0994	920	0.00108
Medium	15	19.13	50.5	0.0504	920	0.00108
Small	15	19.13	22.2	0.0220	920	0.00108

Average..... 0.00109
 Adding 2 per cent for field distortion.. 0.0011

the emission in terms of the roentgen is 0.070 r per minute per gram.

We have already mentioned the reason for providing three cones of different apertures for these experiments. From the last column of Table I it will be seen that in general the large cone gave higher readings than the two smaller ones. It is difficult to say, however, whether the difference is really significant. The last experiments, which were performed under more nearly ideal conditions, do not show this difference. At any rate it is evident that no serious spurious factors were introduced by the arrangements chosen for the production of well-defined beams of gamma rays.

We must consider now the requirement of "complete utilization of the secondary electrons" in the definition of the roentgen.

Gamma rays produce secondary electrons which are capable of traversing several meters of atmospheric air. Theoretically, therefore, the ionization chamber should have the dimensions of a large room. Our chamber, of course, is much smaller, and so it becomes necessary to estimate what error is introduced by this factor.

From previous experiments we know the distribution of the electrostatic field in our standard chamber, for different sizes of collecting electrodes and different distances between electrodes. Referring to these (published) data (12) it will be seen that the field under the collecting electrode is not quite uniform when the spacing is greater than 15 cm., even if only the central strip of the composite electrode is used. To determine the correction for field distortion

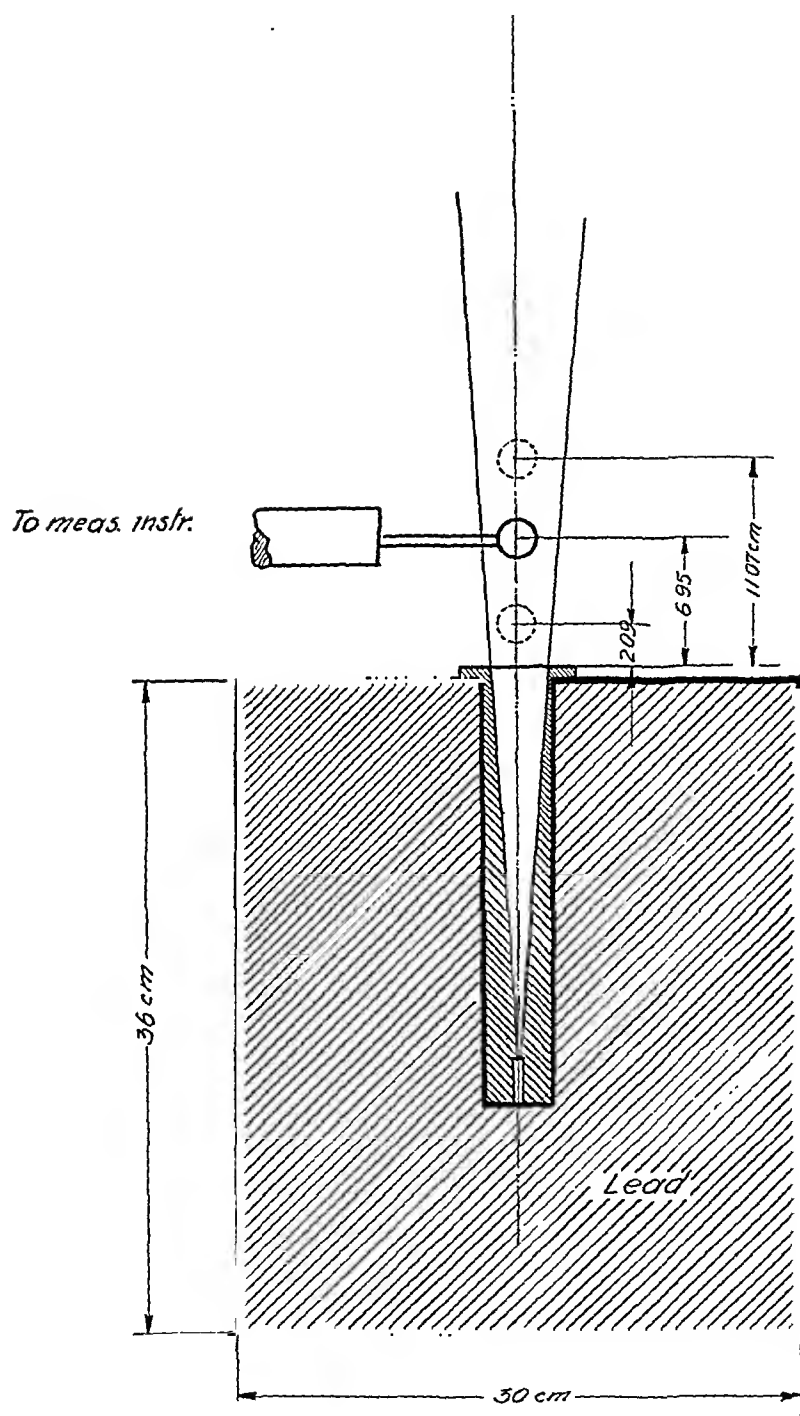


Fig. 14. Set-up for calibration of spherical lead chamber.

should be remembered that the ionization of air by gamma rays is due very largely to the process of scattering (Compton effect), most of the ionization being produced by "recoil electrons." These electrons do not

their contribution to the ionization in the standard chamber. This problem is being investigated further.

By referring again to Figure 13 it will be seen that a correction for field distortion

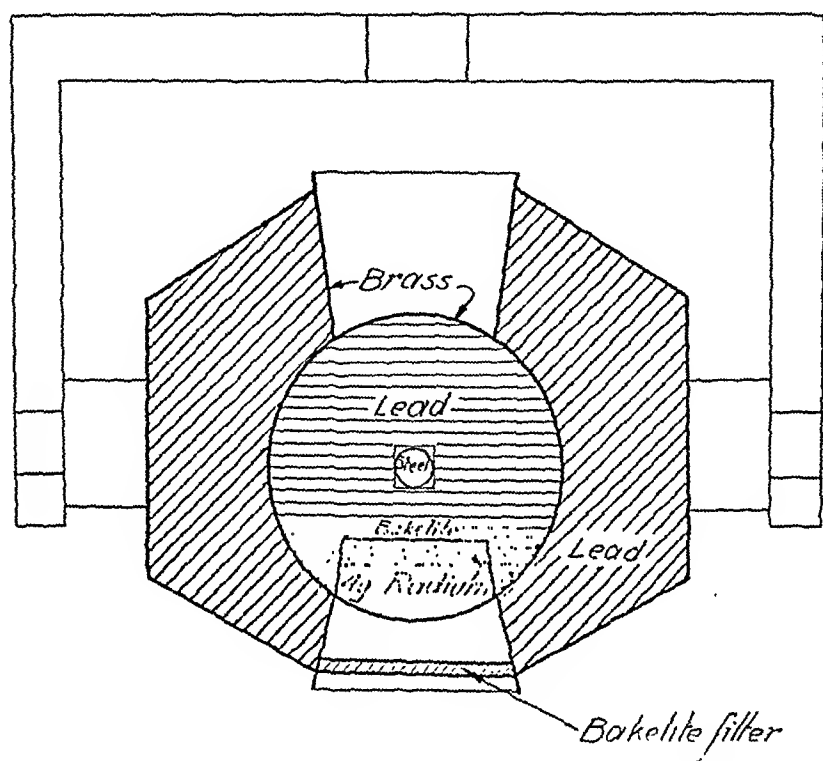


Fig. 16. Cross-section of radium "pack."

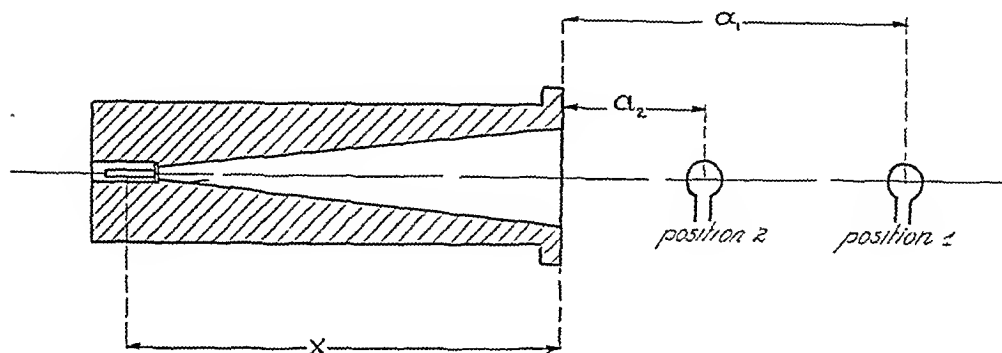
travel very far in atmospheric air unless the radiation which gives rise to them is of extremely short wave length. The gamma radiation of radium filtered by two millimeters of brass still has a considerable proportion of the softer components of the emitted rays; nevertheless, the average wave length is much shorter than ordinary X-rays and some recoil electrons (as well as the photo-electrons) must be capable of traversing several meters of air. These high speed electrons do not produce much ionization per centimeter of air until their velocity has been reduced considerably; therefore, it is very difficult to make a reasonable estimate of

in the chamber must be made. According to the curve for the small X-ray beam, the ionization for a 15 cm. electrode spacing is about 2 per cent less than the constant value for spacings between 8 and 11 cm.; therefore, the gamma-ray emission determined with the chamber under comparable conditions must be increased by this amount. The corrected value is 0.071 r per minute per gram of radium.

The above figure refers to a point at the mouth of the lead cones, just as in the case of X-rays the measurement with the standard chamber refers to the intensity at the point where the diaphragm is located. On

under the conditions of the gamma-ray measurements, the following test was made. A narrow beam of X-rays was passed through the chamber with the five center plates acting as collecting electrode. A volt-

ration reaches about 11 cm., and then decreases gradually, this decrease being an indication of the effect of field distortion. With the large X-ray beam the effect (curve b) is more marked. But it is important to



by inverse square relation

$$X = \frac{\alpha_1 - \alpha_2 \sqrt{\frac{I_2}{I_1}}}{\sqrt{\frac{I_2}{I_1}} - 1} \quad \text{where: } I_1 = \text{ionization current for pos 1}$$

$I_2 = \text{ " " " " " " " 2}$

Fig. 15. Determination of "effective" distance of gamma-ray source.

age high enough for complete saturation with the greatest spacing was applied. Ionization readings were then taken for different spacings up to 22 cm., the results being shown by curve a of Figure 13. Then an X-ray beam of approximately the same diameter as the largest gamma-ray beam used was passed through the chamber and again readings were taken for different distances between electrodes. Curve b of Figure 13 was thus obtained. The circles in the same figure represent the readings obtained when the same experiment was performed with the large conical beam of gamma rays traversing the chamber.

It will be seen that in the case of the small X-ray beam the ionization remains practically constant until the electrode separation

note that the points (circles) for the corresponding gamma-ray experiment fall very close to this curve. From this we may infer that the ionization produced by the gamma-ray beam is largely confined within the geometrical beam, as in the case of X-rays. This conclusion is supported by the autophotograph of the beam shown in Figure 5, although there is evidence in the original film of soft radiation outside the cross-section of the beam proper. At any rate it is certain that there is no appreciable increase in ionization when the electrode spacing is increased from 15 to 22 cm., accordingly it is difficult to see how the ionization would be materially increased by increasing the electrode separation to the theoretical limit of several meters. In this connection it

a bakelite disc. 7.5 cm. in diameter, according to the pattern shown in Figure 17. It is important to note that the tubes stand on end, and that the concentration is greatest around the periphery of the circle. The capsules are made of platinum and are approximately 10 mm. high and 5 mm. in diameter, with a wall thickness of 0.35 millimeter. The bakelite disc is supported in the lead container as shown in Figure 16, so that it registers with a conical port in the lead. The center of the capsules is at a distance of 6 cm. from the brim of the port in the position shown.³

The beam of rays passing out of the port is filtered by a minimum of 0.35 mm. of platinum and 1.5 mm. of brass. It should be noted, however, that the effective filtration is considerably greater than this, because some of the rays in passing through the cylindrical walls of the capsules traverse a greater thickness of platinum than 0.35 millimeter. This is also true in the case of the brass filter, on account of its curvature; accordingly, it is difficult to assign a definite value to the effective filter. A disc of bakelite 6 cm. thick was placed at the mouth of the port as a secondary filter in the case of the experiments to be described here.

Since the beam of radiation emitted by the pack is too large and its cross-section is too indefinite to be measured directly with a standard chamber, the following plan was adopted. The spherical lead chamber already described can be calibrated against the standard chamber to read directly in r per minute. This can be done by first measuring a beam of gamma rays with the standard chamber and then taking a reading with the lead chamber at a definite point in the same beam. From the standard chamber reading the intensity at any point in the beam can be calculated, and, therefore, the

TABLE III
CALIBRATION OF SPHERICAL LEAD CHAMBER

Distance of Chamber from		Current (e.s.u.)	Strength of source (mc.)	E.s.u. per gram at 22.5 cm.
Mouth	Apex			
2.1	24.6	0.0262	815	0.0382
2.8	25.3	0.0222	743	0.0378
4.0	26.5	0.0222	794	0.0388
7.0	29.5	0.0183	815	0.0387
11.1	33.6	0.0140	815	0.0383
14.9	37.4	0.0110	794	0.0383
17.1	39.6	0.0091	743	0.0380

Average..... 0.0383

intensity at the point where the (center of the) lead chamber was placed can be determined. This value of the intensity corresponds, then, to a certain ionization current produced in the lead chamber, and the relation between the two is established. By this method the small chamber is calibrated with radiation of the same quality as that which the chamber is intended to measure later. Accordingly, no uncertainty due to "wall effect" exists, and any material can be used for the construction of the chamber. We used a lead chamber because, for the same air volume, the current is larger, on account of the greater emission of secondary electrons by lead. A graphite chamber was also used and, as expected, the measurements agreed with those made by the lead chamber.

The small chamber thus calibrated was then placed at a definite point in the beam emitted by the radium pack and the intensity at this point was measured directly. The small size of the chamber enabled us to "explore" the beam over its cross-section and at different distances from the radium, beyond the minimum of 6 centimeters. Radiation reaching the chamber from different directions (every radium capsule) registered its full effect on the chamber, on account of its spherical shape and uniform wall thickness.

³By rotating the lead cylinder to which the disc is attached the radiating surface can be made to register with a port on the opposite side of the container. In this position the radium is at a distance of 10 cm. from the brim.

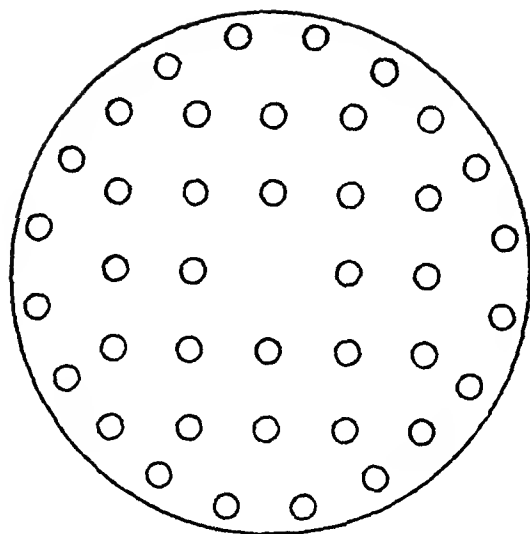


Fig. 17. Distribution of radium tubes in the pack.

account of the appreciable length of the gamma-ray source used in these experiments (12 to 14 mm.), it is desirable to determine experimentally the effective apex of the cone. For this purpose the arrangement shown in Figure 14 was used. S is an approximately spherical ionization chamber 1.9 cm. in diameter, made of lead 1 mm. thick, connected, when in use, to the vacuum tube measuring device by means of a flexible cable. It could be placed, then, at different distances above the large lead cone, in the path of the gamma-ray beam. Taking readings with this chamber in two different positions in the beam, it is possible to calculate the effective apex of the cone, or, in other words, the position of the equivalent point source, with respect to the aperture of the lead cone. The method of calculation is indicated in Figure 15 and the experimental results are given in Table II.

In this manner the average distance of the theoretical point source from the mouth of the cone was found to be 22.5 cm.: by actual measurement the geometric center of the radon tube was 22.1 cm. below the mouth of the same cone. Neither of these

TABLE II

A ₁ (cm.)	A ₂ (cm.)	I ₁ (c.s.u.)	I ₂ (c.s.u.)	X (cm.)
14.9	4.0	0.011	0.0222	22.3
17.1	2.8	0.0091	0.0222	22.4
7.0	2.1	0.0183	0.0262	22.8
11.1	7.0	0.0140	0.0183	22.4
11.1	2.1	0.0140	0.0262	22.5

Average..... 22.5
Measured 22.1 cm. to center of radon tube

two values is strictly correct, but the close agreement between the two serves as further justification of the use of the lead cones and radon tube in the measurement of gamma rays with a standard chamber. The error introduced by taking one or the other of the above values is less than 4 per cent: the one experimentally determined is probably closer to the correct one and, therefore, we shall use this in our calculations. We may say, then, that one gram of radium filtered by 2 mm. of brass emits gamma rays at such a rate that the intensity at a distance of 22.5 cm. is 0.071 r per minute. For purposes of calculation the gamma-ray emission should be given for a one-centimeter distance from a point source. The value is 36 r per minute per gram at one centimeter.

6. *Measurement of the Gamma-ray Emission of a Radium "Pack."*—At the Memorial Hospital we have a large radium "pack" containing 4 grams of radium which is used extensively for therapeutic purposes. It is of interest, therefore, to measure the gamma radiation emitted by this appliance with the idea of expressing in roentgens the quantity of radiation administered to patients. The construction of the pack has been described fully in a previous publication (14). Since, however, certain details are essential for the proper interpretation of the results, they will be repeated here.

Figure 16 shows the cross-section of the heavy lead container. The radium capsules (40 of 100 mg. each) are distributed over

with the cone 27.6 cm.; with the radon suspended in air, 28.2 centimeters. The latter is somewhat greater and, on the basis of the inverse square relation, shows a discrepancy of 4 per cent—not unduly large consid-

sults are shown graphically in Figure 18 and tabulated in Table IV (inserted in the figure). They give the gamma-ray emission of the pack at different distances from the radium, expressed in roentgens per minute.

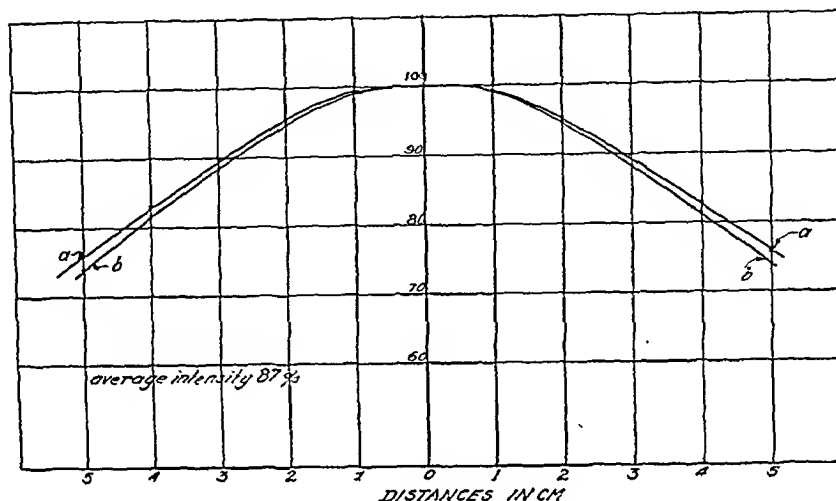


Fig. 19. Distribution of intensity in the cross-section of the beam emitted by the pack at 6 cm. level.

ering the difficulties of the test. The increase in ionization may be accounted for by the scattered radiation in the room, due to the global radiation of the unprotected radon tubes of 800 millicuries. We may conclude from this test that any disturbances in the gamma-ray beam introduced by the presence of the lead around the source cannot be serious.

For the exploration of the beam emitted by the radium pack, the spherical lead chamber was placed in the center of the beam at a distance of 6 cm. from the radium, and a reading taken. Then, since the pack is equipped with a motor drive for vertical adjustments, the ionization chamber was kept in the same position and the pack was raised to different heights. Thus the distance between the radium and the chamber was varied from 6 to 30 cm. without disturbing the chamber in any way. The re-

For distances which are large in comparison to the dimensions of the radiating source, it is proper to apply the inverse square relation; accordingly, we can calculate approximately the emission at different distances from the pack by using the value obtained for a point source by means of the standard chamber. (It will be remembered that this was 36 r/min. per gram at 1 cm. distance.) The measured and calculated intensities at distances from 10 to 30 cm. are given in Table V, the agreement between the two being almost perfect for the longer distances. As a matter of fact, however, the measured intensities should be somewhat lower than the calculated ones, on account of the greater filtration of the radium in the pack. Evidently the decrease in intensity due to the thicker filter is compensated for almost exactly by the scattered radiation which is produced in

In Table III are given the experimental data for the calibration of the spherical lead chamber. Readings taken with the chamber at different distances above the large lead cone are in good agreement when reduced

placing it in the beam of gamma rays issuing from the large lead cone. In the discussion of the cones, reference was made to the possible influence of the mass of lead used to limit the beam. For this reason it

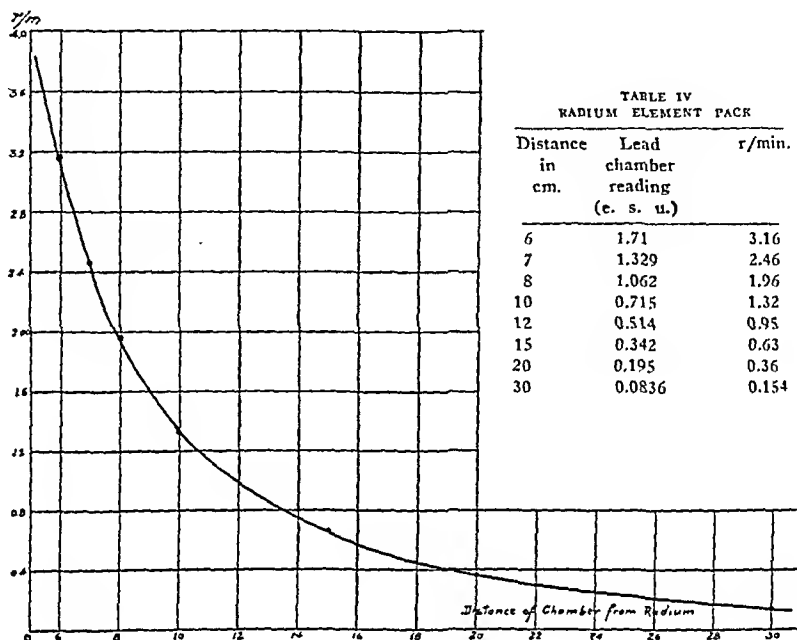


Fig. 18. Gamma-ray emission of radium pack at different distances.

to a distance of 22.5 cm. from one gram of radium. (See last column of Table III.) The average value of the ionization current produced in the lead chamber under these conditions was 0.0383 electrostatic unit. It will be remembered that the gamma-ray emission measured with the standard chamber was found to be 0.071 r/min. per gram for this distance. Therefore

$$0.0383 \text{ e.s.u.} = 0.071 \text{ r/min.}$$

or

$$1 \text{ e.s.u.} = 1.85 \text{ r/min.}$$

Accordingly an ionization current of 1 e.s.u. corresponds to a gamma-ray intensity of 1.85 r per minute.

As already stated, the calibration of the spherical lead chamber was carried out by

was thought desirable to suspend the radon tube in air and then take a reading with the lead chamber at a distance comparable to the one used with the cone. To minimize as much as possible the influence of the strong radon tube on the measuring apparatus proper, since the source was unprotected in all directions, certain precautions had to be taken. A detailed description of the experimental procedure is, perhaps, unnecessary in view of the fact that all sources of error could not be eliminated completely. The test was made by determining the distance from the unprotected radon at which the small chamber had to be placed in order to get the same reading as obtained with the large lead cone. The two distances were:

the distance. The circles on the curve indicate the experimental points. No readings could be taken at the 6 cm. distance because of space limitations when the tank was in place; the value for this distance

the distribution of radiation at the surface of the water over the entire field. An estimate of the average intensity can be made from the data given in Figure 19. It will be remembered that the average intensity at the

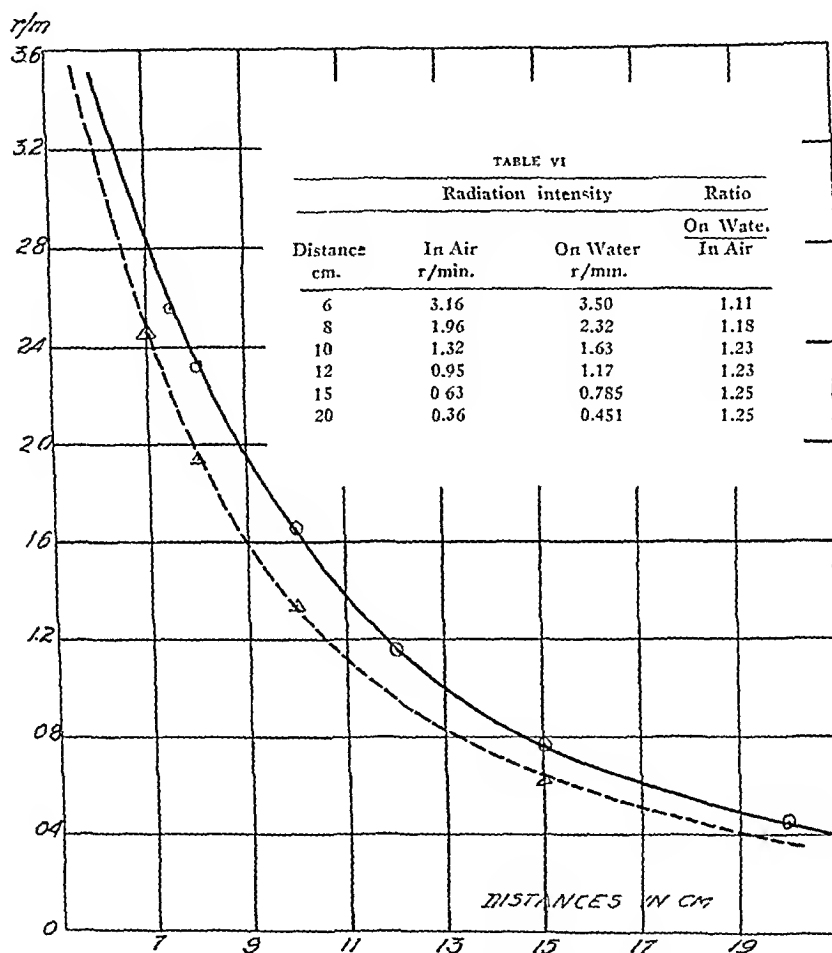


Fig. 20. Gamma-ray emission of radium pack at different distances, including back scattering.

given in the table was obtained by extrapolation and, therefore, is somewhat uncertain. It will be seen, however, that this is sufficiently close for our purposes. The estimated intensity at the surface of the water, in the center of the irradiated field, is, therefore, 3.5 r per minute at the 6 cm. distance.

No experiments were made to determine

6 cm. level in air was calculated to be 87 per cent of the maximum intensity in the beam; for our purposes it is proper to use the same ratio between the maximum and average intensities at the surface of the water. Hence we may say that the average intensity with back scattering at 6 cm. from the radium is 3.15 r per minute.

TABLE V

Distance (cm.)	Intensity in r/min.	
	Measured	Calculated
10	1.32	1.44
12	0.95	1.00
15	0.63	0.64
20	0.36	0.36
30	0.154	0.160

the lead walls of the port in the pack. Considering the geometric relation between the radium tubes and the walls of the port, it is apparent that a considerable amount of scattered radiation must be present in the beam. We might estimate the decrease in intensity due to the greater filtration of the pack to be about 10 per cent, and therefore the scattered radiation must be about the same percentage.

The beam emitted by the pack was also explored in a plane parallel to the radiating surface, at the 6 cm. distance, by moving the spherical lead chamber in a horizontal plane across the mouth of the port, in two directions at right-angles to each other. The results, plotted in percentage of the intensity at the center of the field, are given in Figure 19. The point of maximum intensity (the center) was located for both curves by taking readings from one side of the beam to the other. Averages of corresponding readings were used in plotting the curves.

It will be seen that the intensity is not uniform over the cross-section of the beam, the variation being from 100 per cent at the center to 78 per cent and 74 per cent, respectively, at two points on the periphery, 90 degrees apart. When the whole beam is to be utilized it is necessary, therefore, to take this into account. An average intensity for the whole cross-section at the level explored was calculated to be 87 per cent of the maximum, or 2.75 r per minute.

When the pack is used for therapeutic purposes, the radiation at the level of the

patient's skin is augmented by the radiation scattered back by the patient's body. While it is known that for gamma rays this effect is not large, it is, nevertheless, of sufficient magnitude to be taken into account. Experiments were made, therefore, to obtain a fairly close estimate of "back scatter."

Since it is known that this scattered radiation is much softer than the primary beam, it was thought desirable to make the measurements with a chamber of low absorption, and for this purpose a spherical chamber similar to the lead one was constructed of very thin celluloid. Readings were then taken with this chamber half submerged in a tank of water in the path of the gamma-ray beam, an earthenware tank 31 cm. in diameter and 38 cm. in depth being used. The celluloid chamber was also used without the water tank in order to determine the percentage of radiation scattered back by measurements made with the same chamber. The results are given in Figure 20.

The dotted curve was obtained from measurements with the lead chamber and is reproduced here for purposes of comparison; the triangles represent the results obtained under analogous conditions (ionization chamber in air) with the celluloid chamber; the solid curve is for the measurements with the celluloid chamber at the surface of the water. It may be pointed out, first, that readings taken with the celluloid chamber fall almost exactly on the curve obtained from measurements with the lead chamber, under identical conditions. Then it is evident that the scattered radiation is not a negligible fraction of the primary beam. The data of Table VI (included in Figure 20), derived from the curves, show in addition that the scattered radiation increases rapidly at first and then slowly with the distance from the water at which the pack is placed. This is, of course, to be expected on account of the fact that the volume of water irradiated increases with

in the laboratory are not very sensitive to radiation; therefore, in order to produce unmistakable changes, one is obliged to use very large doses of radiation, and, to do this in a period of time which is short in com-

point of view, lies in the fact that four growing tissues present in the seedlings may be studied under identical environmental conditions. Large numbers of seeds can be handled conveniently in the laboratory, thus

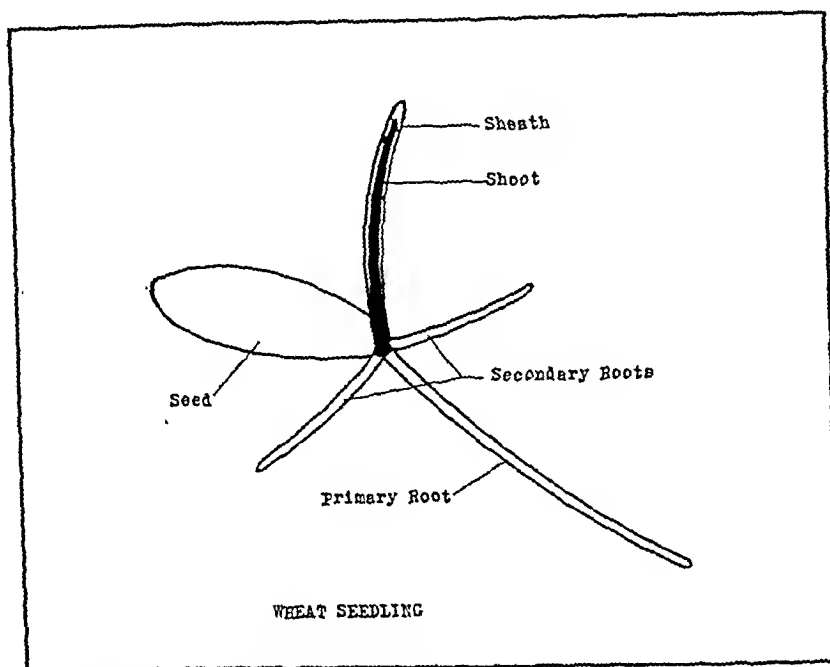


Fig. 21. Schematic representation of growing parts of wheat seedling.

parison to the life cycle of the material, it is necessary to have very powerful sources of radiation. This difficulty was overcome in our experiments by selecting two organisms which are rather sensitive, and by employing the most powerful sources of radiation available.

Germinating seeds (19 to 27 and others) and *Drosophila* eggs (28 to 32) have been employed by various investigators to study radiation effects. Ware Cattell (33), working in this laboratory, studied the growth of wheat seedlings under different conditions and developed a technic which has given reliable results. This material possesses several distinct advantages, in addition to its being reasonably sensitive to radiation. The most important of these, from our

making possible the use of statistical methods.

2. *Experimental Technic.*—The technic employed in our experiments was as follows. Wheat was obtained from the South Dakota Agricultural Experiment Station, the variety which we found to have the greatest fertility and to give the most consistent results being known as "Kota." A large number of seeds were first soaked for three hours in tap water, and from these only the most uniform in size and appearance were selected. These were placed in moist chambers consisting of large Petri dishes with moist filter paper at the bottom. They were allowed to develop in darkness in the moist chambers at 19.5° C. for 18.5 hours. At the end of this period the grow-

TABLE VII
GAMMA-RAY EMISSION OF PACK

Distance (cm.)	With graphite chamber r/min.	With lead chamber r/min.	Ratio
6.5	2.82	2.77	1.02
7.0	2.58	2.47	1.04
8.5	1.84	1.77	1.04
10.0	1.39	1.32	1.05

At this point it may be well to report certain tests made with a spherical graphite chamber, kindly given to us by Dr. Otto Glasser some years ago, and which has been used extensively for X-ray measurements. The ionization current of this chamber is measured by means of a quartz fiber electrometer to which it is attached through a flexible amber cable. Two methods of calibration were employed: (1) By placing the graphite chamber in a beam of gamma rays of known intensity, as for the calibration of the lead chamber; (2) by placing the chamber in an X-ray beam of known intensity, according to the usual procedure. The instrument was then used to determine the gamma-ray emission of the pack. On account of the great thickness of lead present between the radium and the electrometer, the "blank" leakage of the instrument was negligible in all cases. The calibration of the graphite chamber with gamma rays gave us the relation 1 division per minute = 0.383 r per minute. Measuring the emission of the pack at different distances with this calibrated chamber, we obtained the results given in Column 2 of Table VI. The values obtained with the calibrated lead chamber are given in the third column for comparison. The ratios between corresponding readings are shown in the last column. From these it will be seen that the two chambers, when calibrated by gamma rays, give essentially the same values for the intensity

of radiation emitted by the pack. Since the two chambers differ widely in absorbing power, this close agreement indicates that the quality of gamma rays used for the calibration is essentially the same as the quality of the gamma radiation emitted by the pack.

The calibration factor for the graphite chamber obtained with hard X-rays of the type generally used in therapy, was found to be 1 division per minute = 1.47 r per minute. Applying this to the readings obtained for the pack, we find the gamma-ray emission to be 5.3 r per minute at a distance of 10 centimeters. It is important to note that this is 3.8 times larger than the value obtained with the same chamber when calibrated with gamma rays.

Such a large discrepancy could not be predicted and is difficult to account for. At the present time we can offer no satisfactory explanation, but the problem is being investigated further. Accordingly, the value given here for the gamma-ray emission of one gram of radium at one centimeter distance (36 r/min.) should be regarded as a preliminary estimate which is subject to modification later. A simpler way of investigating the problem is now available to us. The 900 K.V. X-ray tube recently developed by Dr. Coolidge has been installed at the Memorial Hospital. This produces radiation comparable in quality to the gamma rays of radium, but of much greater intensity than is possible to obtain with the present radium supply of the Hospital, and, therefore, our measurements will be facilitated considerably.

PART II (BIOLOGICAL)

1. *Selection of Material.*—In attempting to study quantitatively the biological action of radiation one is confronted with many practical difficulties. As a rule, living organisms which can be handled conveniently

fairly homogeneous, and of high penetrating power, to minimize inequalities in the distribution of radiation within the biological material. These requirements were met by operating the X-ray tube at 165 K.V. and

maintain the conditions under which it had been calibrated. A stabilizer in the tube circuit kept the current practically constant at 20 ma. throughout. The primary voltage of the transformer could be adjusted to the de-

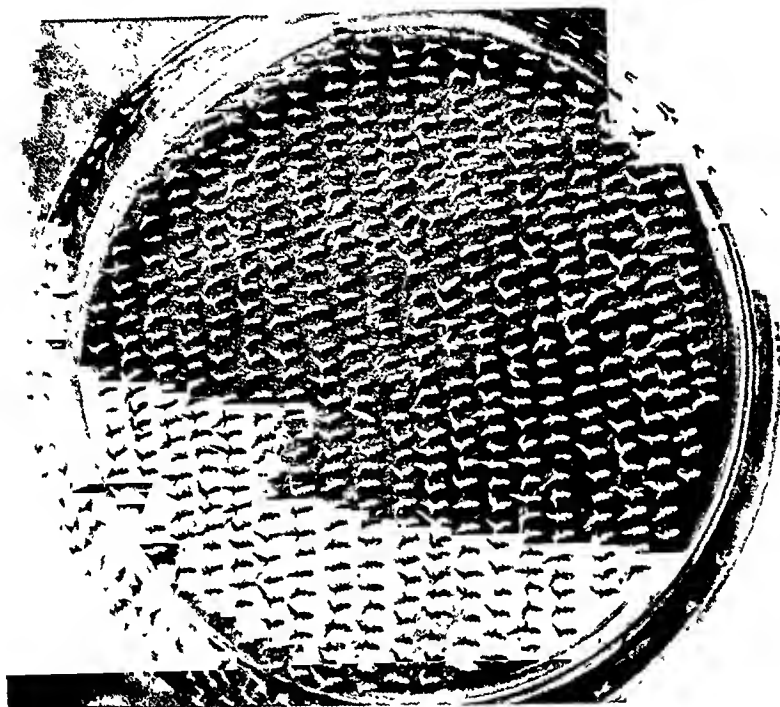


Fig. 23-A Wheat seedlings 36 hours after germination.

20 ma., using a copper filter 2.04 mm. thick, and placing the material at a distance of 50 cm. from the target.

The intensity of radiation at this distance was measured by means of an ionization chamber which had been calibrated against our standard chamber under analogous conditions. Measurements were made "in air" and with "back scattering," as in the case of the radium pack (See Part I). The same water tank and the same thin-walled celluloid chamber were used. The irradiated field in the case of the X-rays was 12×12 cm., and the back scattering amounted to approximately 50 per cent of the intensity in air. During the irradiation period the X-ray machine was under constant observation to

sired value by means of a slide wire rheostat. In most cases ionization measurements were made before and after the material was irradiated. The intensity was seldom found to be appreciably different.

In order to avoid complications due to secondary radiations the seeds were supported on very thin cellophane (0.025 mm.) while they were being irradiated. Two layers of cellophane were stretched over an ordinary embroidery hoop made of thin wood. On this was placed a piece of moist filter paper. The seedlings were then arranged in rows on the paper with the shoots pointing upward. A second embroidery hoop of smaller diameter with one sheet of cellophane stretched across was then

ing parts of the wheat embryo were bursting through the surface of the swollen seed, and those showing the greatest uniformity as to appearance, vitality, and degree of growth were selected for the experiments.

refer as *secondary roots*. As previously stated, these growing parts are just breaking through the seed coat at the time that the material is utilized in the radiation experiment.

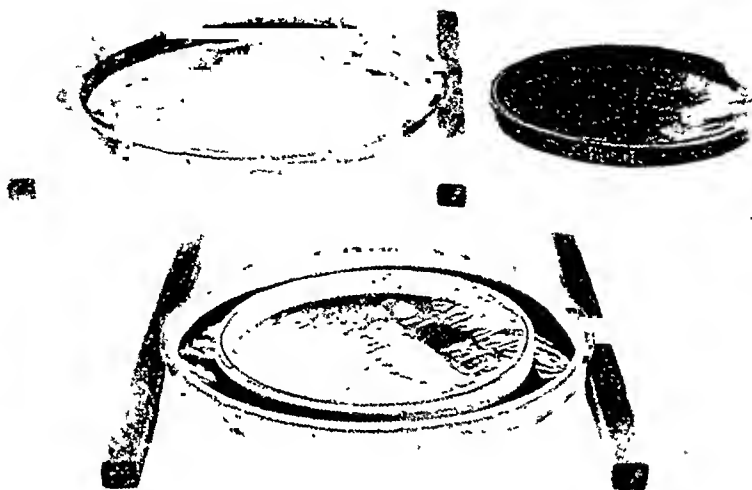


Fig. 22-A (above). Cellophane moist chamber (open).
Fig. 22-B (below). Cellophane moist chamber (closed).

During the first several days of growth of the plantlet five growing parts are present, as shown diagrammatically in Figure 21. Two of these, one within the other, grow upward to form the stalk of the wheat plant, while three grow downward to form the roots. The former consist of the *coleoptile*, or *leaf sheath*, which forms the first leaf above the cotyledon, and a mass of tissue within, which will later push through the coleoptile to form the second leaf. The latter will be spoken of as the *shoot*. Of the three parts growing downward, the one which appears first is the main root coming from the embryo, and this may be called the *primary root*. Following immediately are two lateral roots which are precisely alike in appearance and growth activity; accordingly they may be considered as identical tissues, and to these we shall

Two sources of radiation were employed in this experiment. One, the four-gram radium pack, has already been described in the first part of this paper. The other was a Coolidge X-ray tube with a tungsten water-cooled target so that it could be operated at 200 K.V. and 30 ma. if desired. The power was supplied to the tube by a high tension transformer equipped with a cross-arm switch for full wave rectification. Since the main purpose of the experiment was to compare effects produced by radiation when only the quality factor was varied, the output of radiation was adjusted to equal that of the pack at the respective distances used. This equality was first based on the ionizing power of the radiation and later on its biological effectiveness. It was decided at the outset, however, to use highly filtered X-rays, which could be considered to be

trol seedlings, this variation introduces no serious difficulties.

The seeds were removed from the moist chambers and the length of the growing tissues was measured along a millimeter rule, by one person, to minimize personal errors, the measurements being recorded on an adding machine by a second person. It was found that by recording the measurements for two tissues at a time this laborious procedure was facilitated considerably; nevertheless it required usually about four hours to carry out the measurements for one experiment. In this period of time an appreciable growth takes place, and for this reason the seeds which received the same dose of one type of radiation (as well as the controls) were kept in two separate moist chambers, as previously mentioned. There were then two sets of seedlings (30 in each chamber) for either type of radiation. The sequence of measurement for one set was from controls to those which had received the maximum dose and for the other set the measurements were made in the reverse order. Since the results of the two sets were then averaged, the growth which occurred during the time of measurement was thus taken into account.

In spite of the great care exercised in the experimental procedure, considerable irregularity was found among individual experiments. For this reason seven or eight separate experiments were performed under as nearly identical conditions as practicable. The results given here were derived from these experiments, and are shown as average curves. Points corresponding to single determinations are included in some of the charts in order to show the magnitude of the discrepancy just mentioned.

3. *Results Obtained with Wheat Seedlings.*—After preliminary tests were made with the X-rays in order to get the range of doses to be given the seedlings, the output of the X-ray machine was adjusted to

the same value as that of the radium pack at 6 centimeters. Seedlings were then exposed to the two types of radiation for correspondingly equal periods; accordingly the doses expressed in roentgens were the same in both cases. It was found, however, that under these conditions the gamma rays were about three times as effective as X-rays. It was then decided to increase the output of the X-ray machine to about three times the initial value, in order that substantially equal biological effects might be produced in the seedlings, for the same length of exposure to X-rays and gamma rays.

The results for a number (7 for X-rays and 8 for gamma rays) of these experiments carried out under the same conditions (as nearly as possible) are all given in this paper. In Figure 24 only the effect on the shoots of the seedlings is shown, in order to simplify the discussion. In the upper part of the figure the results are plotted in terms of exposure time in minutes and percentage length of the shoots, taking the average length of the shoots of the controls as 100 per cent. Inspection of the two solid curves shows at a glance that, within the limits of experimental error to be expected in work of this sort, the *nature* of the effect produced by the two types of radiation is essentially the same. Or, strictly speaking, we should say that the variation of the effect with the magnitude of the dose, follows the same law in both cases (although equal doses do not produce the same effect). In other words, to produce a given increment of the effect in both cases the doses must be increased in the same proportion. From this it may be inferred that the primary action of radiation on the material under consideration is essentially the same for the two types.

It will be noted from the legend at the right of the upper curves that the ratio of the intensities of the X-ray and gamma-

placed over the seeds, to reduce the normal evaporation of water. It should be remembered in this connection that the target of the X-ray tube was cooled by circulating water and therefore there was practically no



Fig. 23-B. Control seedlings at the time of measurement.

heat emission from the tube. Accordingly the seeds were not exposed to heat while they were being irradiated with X-rays. In the experiments with gamma rays the cellophane cover was omitted, since the rim of the pack was brought down in contact with the cellophane tray and acted as the cover to retard evaporation. When the water tank was used the cellophane tray was supported in actual contact with the surface of the water by means of a strip of gauze stretched across the tank.

About eight hundred seedlings, selected as previously explained, were used for one experiment. They were divided at random into two equal parts for the radium and X-ray exposures, respectively. From each lot 60 seedlings were picked at random and were kept in small moist chambers as controls. The remainder were placed in two cellophane chambers, each containing about

340 seedlings. One of these and one control dish were taken to the X-ray machine, and the other lot, with its control, was carried to the radium pack room. The exposures were started immediately so that both sets of seedlings were irradiated simultaneously and at the same age. The controls during this period were kept, respectively, in the same room as these undergoing irradiation, to minimize the influence of possible differences in room temperature. In either case they were effectively shielded from radiation.

At the end of a predetermined time of exposure, 60 seedlings were picked from different parts of the cellophane tray and removed to two small moist chambers (30 in each) which were then placed near the control dish. The remaining seeds were again exposed to radiation to continue the treatment. At the end of the second period (usually equal to the first), another lot of 60 seedlings was removed from the cellophane tray as before. This process was continued until the last 60 seeds were given the maximum dose planned for the experiment. Following this, all the moist chambers were taken to the constant temperature chamber and were kept there at 19.5° centigrade.

Seventy hours later (*i.e.*, 94 hours after the seeds were first put to soaking in water), the four parts of the seedling, mentioned above, were measured for linear growth. At this age the shoot and sheath of the control seedlings are usually of the same length—about 30 to 40 mm.: the primary root is 57 to 80 mm. in length, and the secondary root is 33 to 50 millimeters. It will be noted that essentially the same percentage variation is present in the growth of the four tissues. It was found also that the same range of variation in length existed in the case of the irradiated seedlings. Since we are concerned here with ratios between the degree of growth of irradiated and con-

of 2.91. The constancy of this ratio, of course, is a consequence of the close agreement of the two curves in the upper part of the figure. Its magnitude (2.91) indicates that the intensity of the X-ray beam (7.8 r/min.) was not quite high enough in comparison to the intensity of the gamma-ray beam (2.8 r/min.) to produce equal effects in equal exposures. The X-ray intensity should have been $2.91 \times 2.8 = 8.15$ r/min. instead of 7.8 r/min. If a correction on this basis is made in the X-ray curve of the upper part of Figure 24, it comes closer to the gamma-ray curve, as indicated by the dotted line.

We may now consider the results obtained with the other tissues of the wheat seedlings. The average curves for all experiments are shown in Figure 25. As in the case of the shoots (which are also included in this chart), it is evident that the gamma rays were decidedly more effective in reducing the growth of the sheaths, primary and secondary roots. The sensitivity of the four tissues to either type of radiation is different as shown by the position of the curves in the chart, the sheaths being most resistant and the primary roots most sensitive, within a certain range. The crossing of the curves for primary and secondary roots was found in every experiment and therefore is not due to experimental errors. It is of considerable importance but its significance cannot be discussed in this paper.

An analysis of these results may best be made by considering the ratios of the doses required to produce the same degree of effect in each tissue. The ratios are given in Table IX. Those for the shoots (Column 3) are the same as already given in Table VIII.

The same constancy in the ratios for the shoots, already noted, is found in the ratios for the primary roots, but the average value is 3.5 instead of 2.91. We may again conclude, therefore, that the nature of the ef-

TABLE IX

Per cent of growth	Ratio — $\frac{\text{X-ray}}{\text{Gamma ray}}$			
	Sheath	Shoot	Primary root	Secondary root
80	3.22	3.06	3.63	3.71
70	3.26	2.89	3.41	3.44
60		2.84	3.43	3.29
50		2.93	3.57	3.19
40		2.83	3.47	3.06
30				2.92
Average	3.24	2.91	3.50	3.27

fect produced in this tissue by X-rays and gamma rays is essentially the same. The relative sensitivity of this tissue to the two types of radiation is, however, different from that of the shoot. More specifically, the roots of the seedlings, *while more sensitive than the shoots*, require *relatively* more X-radiation than gamma radiation to produce the same degree of effect, throughout the range investigated. The difference is

$$\frac{3.50}{2.91} = 1.20.$$

It is important to determine whether or not this is significant. In the ultimate analysis the question hinges on the relative positions of the curves for shoots and primary roots in the chart of Figure 25, for, the ratios being substantially constant throughout the range, it follows that the two average ratios cannot be made equal except by a proportional shift of all the points on one or more of the four curves involved. In order to attain equality of ratios by changing the position of only one curve, the shift must be about 20 per cent throughout. Since each curve represents the average of seven or eight experiments, it is hardly possible that a *constant percentage* error of this magnitude would be present. On the other hand, if equality of ratios is brought about by changing the positions of all four curves, the required shift in each is 5 per cent plus or minus, which is within the

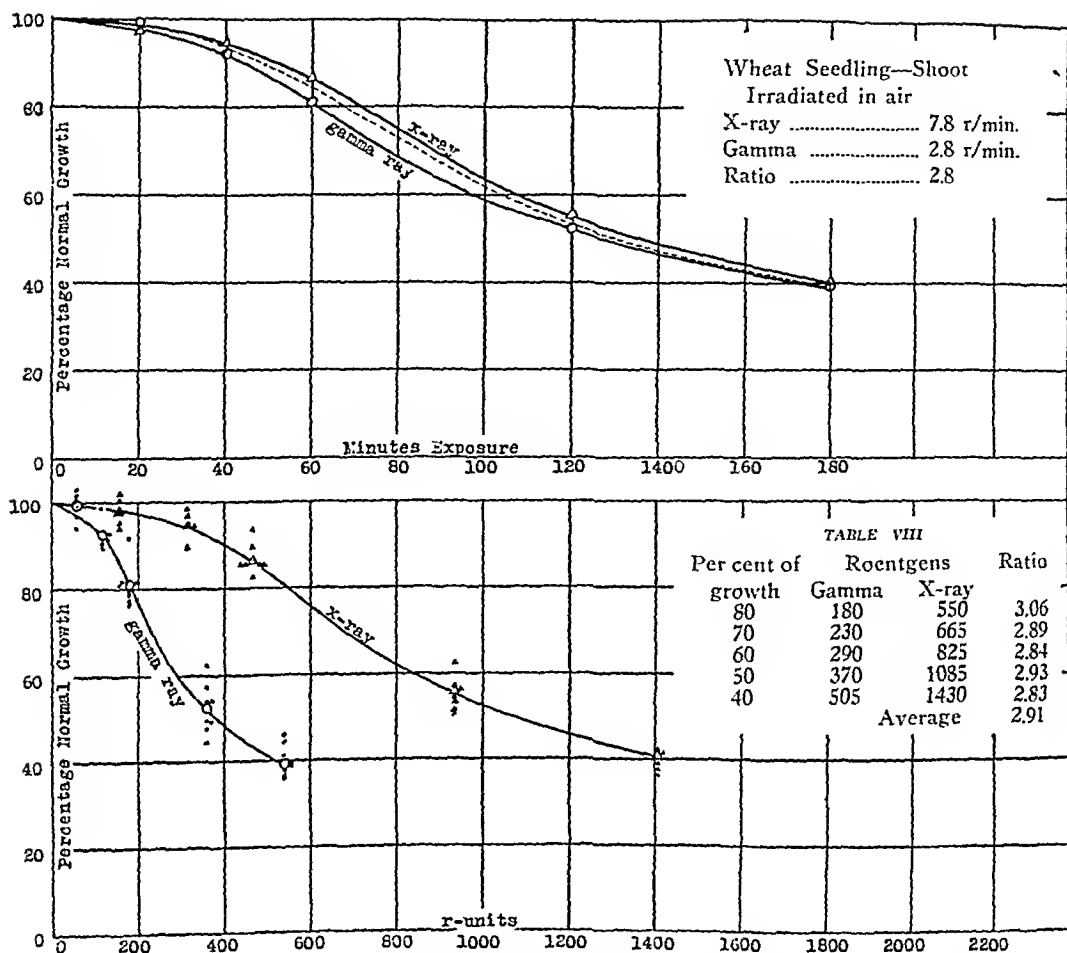


Fig. 24. Curves showing effect of X-rays and gamma rays on the shoot of the wheat seedling.

ray beams used in this experiment is 2.8; therefore, the same effect was produced in the shoot by administering 2.8 times as much X-radiation as gamma radiation in the same length of time.

In the lower part of the chart the same two curves are plotted in terms of quantity of radiation expressed in roentgens. The individual experimental points are shown on this chart to indicate the degree of variation among the different experiments. It is important to note that no points and no experiments in this series have been omitted or discarded for any reason. The curves rep-

resent averages of all experiments. It is evident at a glance that there is a marked difference between the doses required to produce the same decrease in growth with X-rays and gamma rays. The quantitative relation between the two may be best obtained by taking the ratio of the doses required to produce the same degree of effect throughout the range. The values thus obtained are given in Table VIII, which is included in Figure 24.

It will be seen that for values of the percentage growth from 80 to 40 the ratios are essentially the same, with an average value

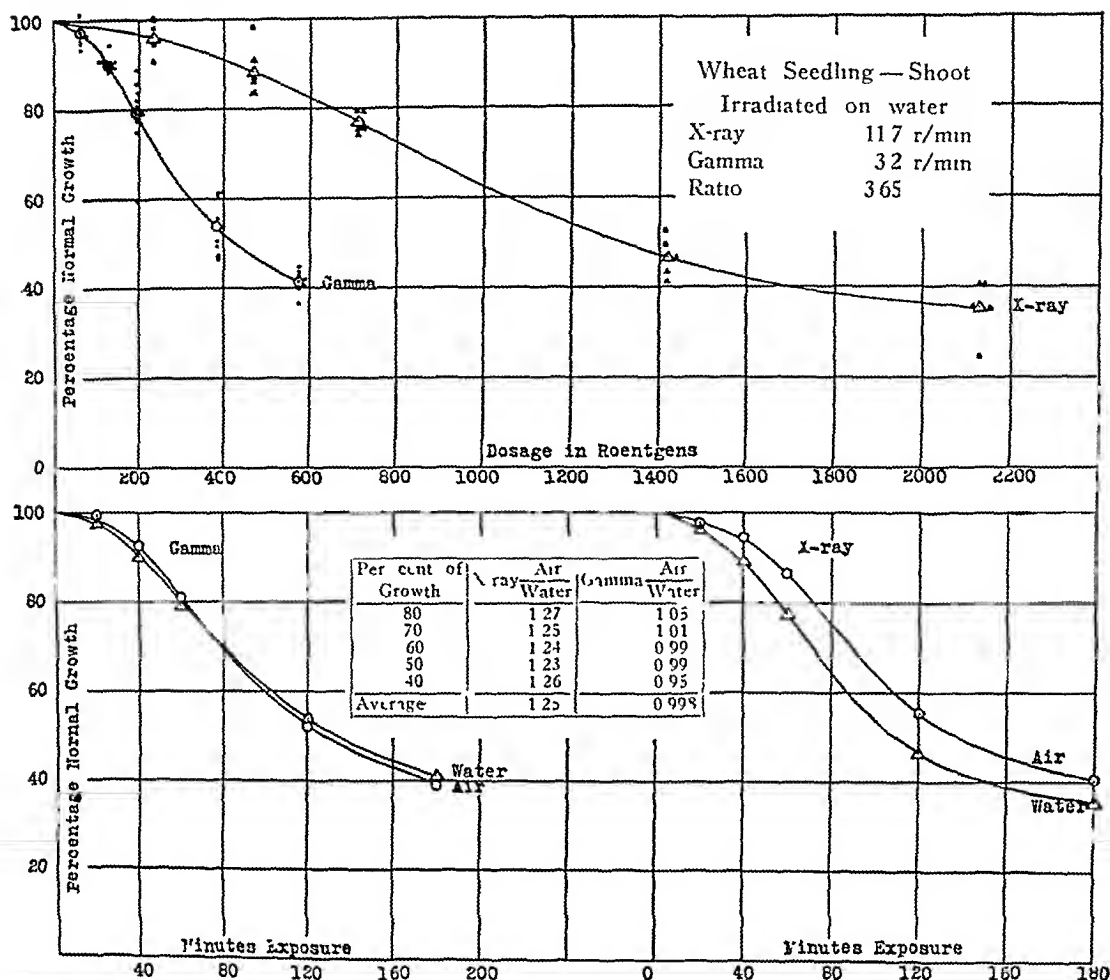


Fig 26 Curves showing the effects of X-rays and gamma rays on the shoot, when irradiated over water to obtain the factor of "back scatter"

The comparison, however, is not quite justified on account of the fact that scattered radiation plays an important part in the erythema reaction, but was purposely reduced to a minimum in the case of these experiments. It seemed desirable, therefore, to investigate the effect of scattered radiation on the seedlings. A large water tank was used as the scattering medium and the seedlings were placed practically in contact with the surface of the water, by resting the cellophane tray on a gauze strip as previously described. The results obtained under these conditions, for the shoots, are given in Figure 26.

In this experiment the output of the X-ray machine was 7.8 r/min, as in the case where no scattering medium was used. Since the increase in scattering was found to be about 50 per cent by measurement with the thin celluloid chamber, we can estimate the intensity at the surface of the water to be 11.7 r/min. In the case of the radium pack we estimated (by extrapolation) the back scattering at 6 cm to be 11 per cent. Hence the average intensity at the level of the seedlings⁵ was 3.2 r/min.

⁵The seedlings projected into the rim of the pack about 2 mm, therefore, the distance from the radium was 5.8 cm and not 6 centimeters. Allowance for the shorter distance has been made in the values given.

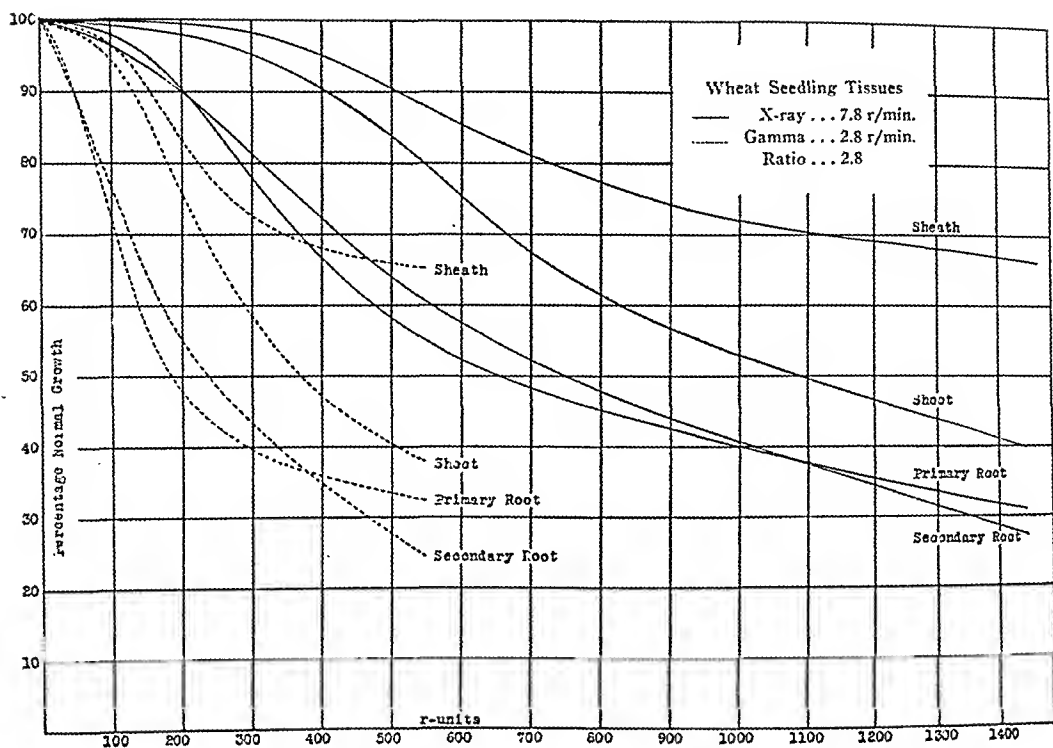


Fig. 25. Curves showing effect of X-rays and gamma rays on four growing parts of wheat seedling.

limits of experimental error. Hence on this basis we would conclude that the difference in the two average ratios is not significant, and that the existence of a differential effect of X-rays and gamma rays is not definitely established by the seedling experiments. There is, nevertheless, a reasonable indication of its existence.

The ratio for the secondary roots (last column of Table IX) is not very constant throughout the range. By inspection of the curves of Figure 25, it will be noted, however, that the most accurate ratios are those determined from points on the steep part of the curves, which fall between the 60 and 40 per cent growth levels. For these points the difference between irradiated seedlings and controls is large, and errors in linear measurements are relatively less important. Furthermore, the position of this portion of the curve is affected but little by

appreciable differences in the experimental points, on account of the steep slope of the curve in that region. Considering, therefore, the secondary root ratios for the 60, 50, and 40 per cent growth points, the discrepancy is not large enough to be significant, on the basis of the information available at present.

The average ratio for this tissue falls between the ratios for shoot and primary root, the difference being too small to be attributed definitely to a differential effect. The same conclusion applies to the ratios for the sheaths, particularly since the two values given in the table refer to points on the upper part of the curves.

It will be seen later that X-rays and gamma rays are about equally effective in producing erythema on the human skin, whereas in the experiments just described gamma rays are distinctly more effective.

as will be seen from the table incorporated in Figure 26.

These results may be explained, at least in part, by the following considerations. The scattered radiation as measured by the celluloid chamber amounted to 11 per cent in the case of gamma rays. This radiation, being considerably softer than the primary radiation, is less effective biologically, for the same reason that X-rays are less effective than gamma rays, according to our experiments. Therefore, its contribution to the observed effect was less than 11 per cent by an unknown amount, which brings the difference within the experimental error.

In the case of X-rays the discrepancy between ionization measurements and biological effect is greater and more difficult to account for. In addition to the above-mentioned influence of the difference in quality between primary and scattered radiations, we may consider the question of position of the shoots with respect to the surface of the water. For this purpose we may include the corresponding results obtained with other growing parts of the seedlings. The ratio of time exposures to X-rays required to produce equal effects in the primary roots irradiated in air and on water was found to be 1.58; the corresponding ratio for the secondary roots was 1.32. We have, then, the following graded variation in these ratios: for shoots 1.25, for secondary roots 1.32, for primary roots 1.58, and for ionization in the celluloid chamber 1.50. If we consider the relative positions of the three tissues with respect to the surface of the water, we find that they are in the above order, the shoots being farthest and the primary roots closest to the water. (The ionization chamber was half submerged.) The difference in distance for the tissues, of course, is not large. Assuming, however, the presence of some very soft secondary radiation at the surface

TABLE X

Ratio — $\frac{\text{X-ray dose}}{\text{Gamma-ray dose}}$				
	Shoot	Primary root	Eggs	Erythema
Without "scatter"	2.9	3.5	4.1	
With "scatter"	2.8	3.6	3.8	1.2

of the water, the difference in the position of the tissues may readily account for the observed results. The seed itself would emit secondary radiation, but it would nevertheless screen the shoot from a considerable part of the very soft radiation originating in the water.

It would seem, therefore, that there is good agreement between the percentage of back scattering determined by ionization in a very light chamber half submerged in water, and that determined by a biological material placed very close to the surface of the water. This conclusion is confirmed by the results obtained with fly eggs, as will be seen later. Nevertheless the problem deserves further investigation.

On the basis of the experimental results we can calculate the effective intensities of the X-ray and gamma-ray beams at the surface of the water. From these, we obtain 2.84 as the average ratio of X-ray and gamma-ray doses required to produce the same degree of effect in the seedling shoots, a result which agrees very closely with the average value of 2.91 found in the case of seedlings irradiated in air. The corresponding ratio calculated on the basis of the intensities measured with the celluloid chamber was found to be 3.14, which differs from 2.91 by 8 per cent. Therefore, no matter how the ratios are obtained, it is evident that gamma rays are about three times as effective as hard X-rays in producing the

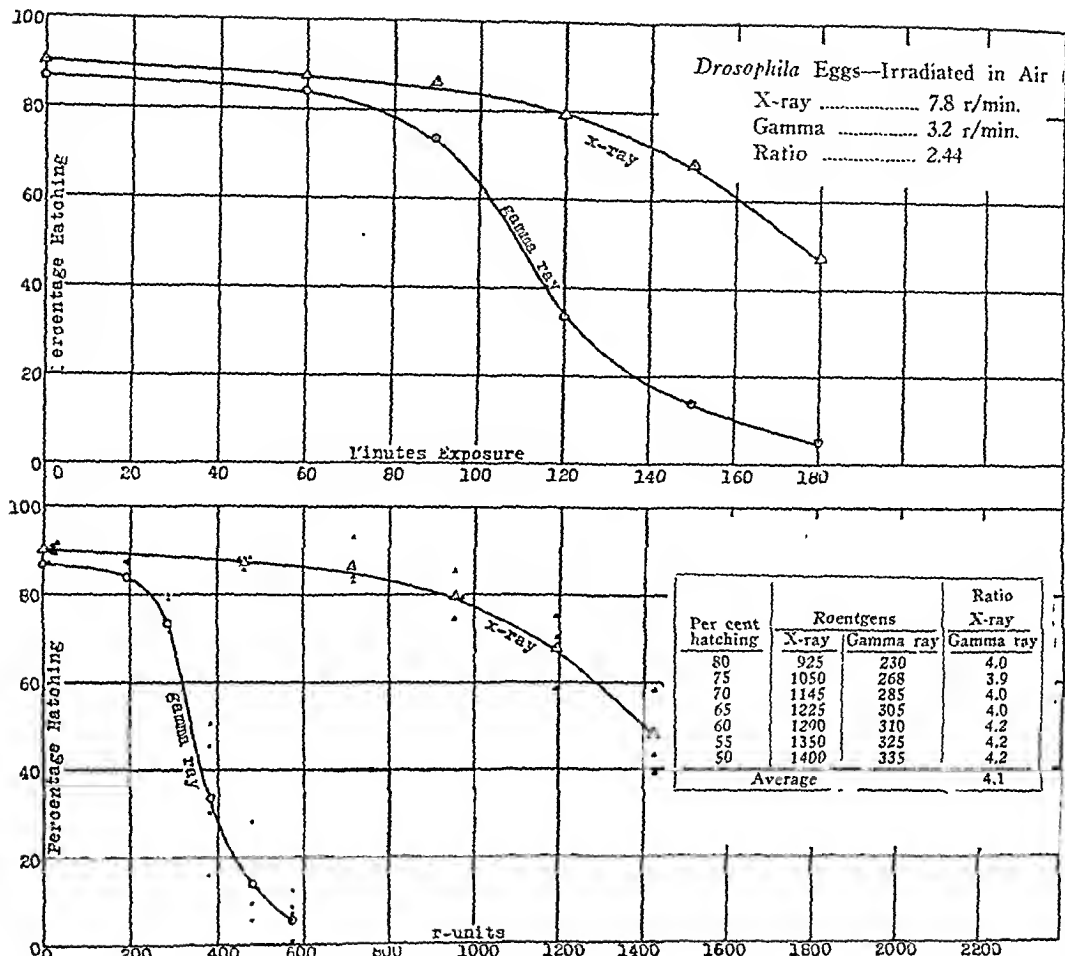


Fig. 27. Curves showing the effects of X-rays and gamma rays on *Drosophila* eggs 3 to 5 hours old.

The curves in the upper part of the figure were plotted from these values.

The average ratio of gamma-ray and X-ray doses for equal effects was found to be 3.14. In view of the fact that the corresponding ratio in the case of the seedlings irradiated in air was found to be 2.91, we may conclude at once that the admixture of scattered radiation does not alter materially the relative effectiveness of X-rays and gamma rays.

It is of interest to note, however, that the increase in biological effect due to the pres-

ence of scattered radiation was not found to be in accord with our estimates; in fact, no increase is apparent in the case of gamma rays. The curves and table in the lower part of Figure 26 show this very well, the curves being plotted in terms of time of exposure. Accordingly, the fact that the two gamma-ray curves practically coincide indicates that the radiation scattered by the water contributed little, if at all, to the effect on the seedlings. In the case of X-rays the contribution amounted to about 25 per cent,

may conclude that there is a differential effect due to the quality of radiation between seedling shoots and *Drosophila* eggs when irradiated under the conditions of our experiments.

Similar experiments carried out with the eggs on the surface of the water in a large tank gave the following results. The scattered radiation in the case of gamma rays had apparently no influence on the eggs, the ratio for equal exposure times with and without water being practically one. In the case of X-rays the scattered radiation amounted to 43 per cent as determined by its effect on the fly eggs. The ratio of X-ray to gamma-ray doses for equal effects, when back scattering was included, was found to be 3.8, which agrees with the corresponding value for eggs irradiated in air (4.1) to within 8 per cent and confirms the general conclusion previously reached.

5. *Comparison on the Basis of Skin Erythema.*—The fact that gamma rays, when measured according to the method described in Part I, are three to four times more effective, biologically, than X-rays, raises the question as to whether the conditions of measurement are comparable to those existing in the biological media employed. It has been pointed out already, however, that the ratio of effectiveness is not the same for all the tissues investigated. This suggests the existence of a *true differential effect with respect to quality which is independent of any method of measurement.*

Since both radium and X-rays have been used at the Memorial Hospital for many years in the treatment of patients, the amounts of these two types of radiation required to produce skin erythema are known with a fair degree of accuracy. Furthermore, numerous skin tests have been made by members of this laboratory during the last ten years to establish the "threshold erythema" doses under proper experimental conditions. Accordingly we are in a position

to compare X-rays and gamma rays as to their relative effectiveness in producing erythema of the human skin.

Considering first the experimental data on threshold erythema (15, 16, 17, 18), we have: A tube of radon filtered by 2 mm. of brass and 2.4 mm. of pure gum rubber placed at a distance of 2 cm. from the skin, produces an erythema on the average patient with an exposure of 830 millicurie-hours. If the tube is considered as a point source, this corresponds to 450 roentgens. Applying a correction of 5 per cent for the length of the radon tube used at this distance, according to charts published from this laboratory (15), the threshold erythema dose under these conditions reduces to 430 r.

Threshold erythema doses for the pack are not known with the same degree of accuracy, because therapeutic doses are seldom administered at one sitting. A fair estimate for the 6 cm. distance is 10,500 mg.-hrs., and for the 10 cm. distance 22,000 mg.-hours.⁷ Using these figures, we find that the erythema dose with the pack is 500 r, *including back scattering and taking the intensity at the center of the beam as a basis of calculation.* If the *average intensity* over the field is taken instead, the dose reduces to 480 r. It is difficult to decide which one of these two values really applies. Accordingly we may take for our present purposes 500 r as the most probable value for the erythema dose when gamma rays are used. This, of course, is based on the measurement of gamma rays according to the method described here.

Similar uncertainties exist in regard to the erythema dose for X-rays. From our own experience and the values reported in the literature, we may say that 600 r delivered by hard X-rays (say, 200 K.V. and 0.5 mm. copper filter) will produce an erythema comparable with that produced by

⁷Values for radium packs applied at a distance of 6 cm. which have appeared in the literature range from 9,000 to 12,000 mg.-hours.

biological changes observed in the wheat seedling shoots.

4. *Results Obtained with *Drosophila* Eggs.*—The technic of collection of *Drosophila* eggs has been described by Packard (29), who has used this material very extensively in his work with radiation. Essentially the same procedure was followed by us.

Preliminary experiments showed that the sensitivity of the eggs to radiation varies markedly with age. Eggs three to five hours old are about five times more resistant than eggs one hour old, reckoning age from the end of a two-hour collection. This is true for both X-rays and gamma rays. It is important, therefore, to know the age of the eggs at the time they are irradiated, or at least to make sure that eggs within the same age range are used throughout. In our experiments it was decided to irradiate both seedlings and eggs simultaneously, in order to eliminate any possible variations in dosage between the two determinations, and for this purpose it was necessary to have a large supply of eggs available at a definite time (when the seedlings were of the proper age). For practical reasons this could be done best by collecting the eggs the day before they were to be irradiated.

Eggs were always collected from actively laying flies within a period of from two to three hours and were removed immediately to a refrigerator, and kept there at a constant temperature of 12° C. until the following morning. At this temperature development is brought almost, if not entirely, to a standstill. The manipulations necessary in the preparation of the eggs for irradiation necessitated exposure of the eggs to room temperature of 21 to 26° C. for a certain period—from three to four hours in each case. Eggs were spread evenly over small pieces of black filter paper about 1 cm. square, which were then placed in the central portion of the cellophane moist cham-

bers containing wheat seedlings. It is evident that the age of the eggs used in the experiments is not known very definitely. However, the same technic was used throughout and there were no large differences in age even though we may not be able to assign a definite value to the equivalent average age. Indirectly this is shown by the close agreement of the results obtained at different times.

The experimental results are given in Figure 27. Since the eggs were placed in the center of the cellophane dishes, the intensity measured at this point in the gamma-ray beam (3.16 r/min.) has been used in the calculation of doses. The ratio of the intensities for X-rays and gamma rays is, therefore, 2.47. From the curves in the upper part of Figure 27 it is evident that, in spite of this difference in intensity in favor of X-rays, the gamma rays produced much more marked effects in equal exposures: the relative effectiveness of the two may be expressed again as a ratio of doses for the same degree of effect. The ratios obtained from the curves in the lower part of the figure are given in the table. As in the case of the wheat seedlings, the constancy of the ratio is also present here: the average value is 4.1.

In this connection it should be recalled that the conditions of irradiation for seedlings and eggs were identical, since they were exposed simultaneously. (The difference in the gamma-ray intensity noted above was due to the fact that the eggs occupied a small area at the center of the cellophane dish, whereas the seedlings were spread throughout the remaining portion of the field.) Nevertheless the dosage ratio in the case of the seedling shoots was found to be 2.9, and, in the case of the fly eggs, 4.1.⁶ Since the difference between the two cannot be attributed to experimental errors, we

⁶If the average instead of the maximum intensity is taken as applying to the eggs as well as the seedlings, the ratio becomes 4.6

hour. Irradiating *Drosophila* eggs of a certain age under these conditions we find that 50 per cent are killed by an exposure of two hours. We conclude from this that the erythema dose is one-half that required to kill 50 per cent of the eggs at this age. We then acquire four grams of radium for use in a "pack" and we wish to determine the erythema dose in milligram-hours for a certain setting of the appliance. Using *Drosophila* eggs of the same age as those irradiated with X-rays, we find that at a distance of six centimeters from the radium, 50 per cent are killed by an exposure of one and one-half hours. From the ratio obtained in the case of X-rays we conclude that an exposure of three-quarters of an hour given with the pack at 6 cm. should produce an erythema. The milligram-hour dose determined in this way would then be $4,000 \times \frac{3}{4} = 3,000$ mg.-hrs., which is about one-third of the correct value (10,500 mg.-hrs.). Therefore, on this basis patients would be undertreated (if one intended to administer an erythema dose). Reversing the procedure outlined above so as to "calibrate" by means of *Drosophila* eggs an X-ray machine from a knowledge of the erythema dose for the radium pack, would result in the administration of X-ray doses about three times larger than the erythema dose—with probable disastrous consequences.

(2) Having once found a difference in the biological effectiveness of gamma rays relative to that of X-rays, for some tissues, it follows that similar differences may be found for other tissues. In particular such differences may be present in the case of normal and pathological tissues of the human body. Accordingly the relative sensitiveness of these tissues must be determined for each quality of radiation employed. It may be found then that some tissues are relatively much more sensitive to gamma rays than to X-rays, and *vice versa*. This will provide a criterion for the selection of the type of

radiation best suited for the treatment of any particular case. X-rays of a certain quality may be best in some instances and gamma rays in others.

(3) The greatest difference reported in this paper was found between the tissues used in the experiments and human skin. That is, gamma rays are three to four times more effective than X-rays in producing changes in wheat seedlings and *Drosophila* eggs, but they are only 1.2 times as effective in producing skin erythema. Since the experimental tissues were all embryonic, rapidly growing and rather sensitive to radiation, we may draw the provisional conclusion that these three properties of the tissues investigated were responsible, at least in part, for the observed results. These properties are also found in some human cancers. In such cases there should be a noticeable differential effect with respect to the quality of radiation.

Unequivocal experimental information bearing directly on this point is not available at present. There is, however, considerable subjective evidence based on clinical observations, which substantiates our conclusions. Radiologists who have used X-rays or large quantities of radium for the treatment of deep-seated tumors by external applications, are of the opinion that better results are obtained in *some cases* by radium than by X-ray treatments. For the proper interpretation of this observation one must consider the dose of radiation which can be delivered by the two methods. While gamma rays are much more penetrating than the hardest X-rays used so far, practical limitations of the quantity of radium available make it impossible to place the source at a great distance from the skin. Hence the advantage of greater penetrating power is more than offset by the operation of the inverse square law. In fact, it is found by actual measurements that hard X-rays deliver to a depth of 10 cm. in a water phantom, about 35 to 40 per cent of the radiation reaching the sur-

500 r of gamma radiation. The erythema in both these instances is probably more marked than our threshold erythema, for which the gamma-ray dose is known to be 425 r. For purposes of comparison, we shall use 500 r for gamma rays and 600 r for X-rays. This makes the ratio between the two 1.2 as against 3 to 4 found for the seedling and fly tissues studied experimentally.

It is important to note that the difference between these ratios is much greater than the uncertainty in the individual values used. Furthermore, this difference is independent of our method of measurement of gamma rays. Thus if we measure gamma rays by means of a small (graphite) chamber, as done by Glasser, the absolute values of the gamma-ray doses will all be about four times larger. The erythema dose for gamma rays will then be about 2,000 r, which is 3.3 times larger than the X-ray dose of 600 r. On the other hand, the doses which produce equal effects in *Drosophila* eggs will be about the same for both X-rays and gamma rays. Therefore, no matter how the radiation is measured, there is a distinct difference in the effectiveness of X-rays and gamma rays, for some biological effects.

6. *Discussion*.—The results derived from our biological experiments are summarized in Table X. They represent averages in two different respects: (1) At least several entirely separate experiments were carried out (both with and without "scatter") from which average curves were obtained; (2) then ratios were obtained from these curves for different degrees of effect and the average of these for each tissue was determined. By this treatment of the results biological variation and experimental errors are reduced to a minimum.

Each figure in the table represents the ratio of the X-ray dose to the gamma-ray dose required to produce the same degree of effect in a given biological material. Since all the ratios are greater than one, it is

evident that in every case it takes more X-radiation than gamma radiation to produce the same degree of biological effect. But it is most important to note that the *greater relative effectiveness of gamma rays is not the same for all tissues investigated*. Thus gamma rays are 2.9 times as effective as X-rays in reducing the growth of the shoots of the wheat seedlings, but they are 4.1 times as effective in killing *Drosophila* eggs. In producing skin erythema this greater effectiveness is only 1.2 times that of X-rays. These differences are so large that they cannot be attributed to uncertainties in the individual values, considering the method by which they were obtained. We must conclude, therefore, that they establish the existence of the differential action of radiation (with respect to quality), which has been suspected but has never before been demonstrated experimentally.

This conclusion is independent of the method by which radiation is measured, since it is based only on the differences found among the dosage ratios for various tissues. The measurement of gamma rays by the method described in Part I influences only the *magnitude* of the individual ratios, but *not the relative values*.

Certain conclusions of some practical importance may be derived from these results:

(1) There can be no unit of radiation (physical or biological) which expresses its biological effectiveness irrespective of quality, over a wide enough range to include gamma rays. A "biological" unit is no better in this respect than one based on some physical effect produced by radiation of the type considered here.

This is evident from the following illustration, in which we shall purposely avoid any reference to a common physical unit of radiation for both X-rays and gamma rays. Suppose that we know the exposure time to produce an erythema, with a certain X-ray machine under definite conditions, to be one

- (14) Idem: The Design of a Well-protected Radium Pack. Am. Jour. Roentgenol. and Rad. Ther., August, 1928, XX, 128.
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7. *Summary.*—(a) A direct method of measuring gamma rays in roentgens has been described. In principle, it is the same as the one ordinarily used for standardization measurements with X-rays. With the method and apparatus used by us the gamma-ray emission of one gram of radium was found to be 36 r/min. at a distance of one centimeter.

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series of bowel obstructions, the first to report for operation, indicative of the significance of local physical findings in the early diagnosis of all acute abdominal disasters.

Abuse of Enemas.—Next in importance in

nation was made the nature of the obstruction was, of course, determined.

This criterion has been subjected to experimental scrutiny in the laboratory by severing the lower ileum of dogs and in-

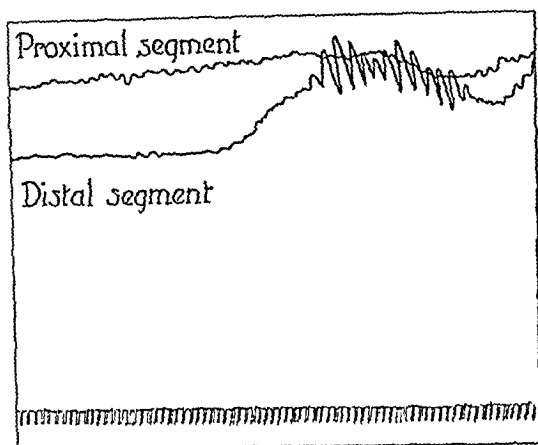


Fig 1. Tracing made by placing a small rubber balloon in the obstructed segment and another in the intestinal loop distal to the site of obstruction. In this tracing the activity of the distal bowel is greater than in the proximal. The reaction to hypertonic intravenous saline and other stimulating agents is the same in the bowel distal to the obstruction as in the proximal.

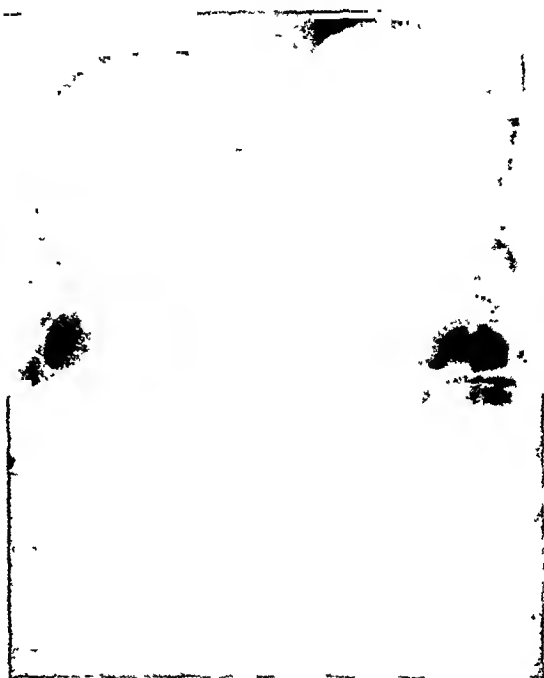


Fig. 2. Gaseous distention of a short loop of small intestine on the left side of the abdomen in a patient with acute intestinal obstruction of 7 hours' duration. A loop of small intestine adherent to the anterior abdominal wall was found near this site.

making an early diagnosis is appreciation of the fact that the patient with acute intestinal obstruction may evacuate gas and feces when an enema is administered. A large number of patients present themselves for surgery with late intestinal obstruction exhibiting meteorism, regurgitant vomiting, and collapse, and come only when all gas distal to the point of obstruction has been evacuated by repeated enemas. Just recently a patient came to my attention who was suspected of having intestinal obstruction but the diagnosis, despite obvious signs of obstruction, was not made because gas continued to be evacuated by enemas. Finally, the patient made his way to the operating table, but before the incision was made gas was spontaneously expelled and the surgeon had him returned to his room. A few hours later he died, and when an autopsy exami-

verting both ends, and it was uniformly found that dogs expel enemas following complete obstruction of the intestine. It is well known that the bowel distal to the point of obstruction is anatomically normal (19). In other animals with an obstruction established in the same manner, but the distal end drawn out to the abdominal wall, it was found that the transit of barium through the distal loop was normal; on the X-ray film this loop usually appeared contracted. When a balloon was placed in the loop distal to the obstruction the peristaltic activity was observed to be similar to that of the normal intestine (3) (Fig. 1). The bowel distal to

ELABORATION OF CRITERIA UPON WHICH THE EARLY DIAGNOSIS OF ACUTE INTESTINAL OBSTRUCTION MAY BE MADE, WITH SPECIAL CONSIDERATION OF THE VALUE OF X-RAY EVIDENCE¹

By OWEN H. WANGENSTEEN, M.D., MINNEAPOLIS, MINN

From the Department of Surgery, University of Minnesota

THE mortality in acute intestinal obstruction continues to be prohibitively high. Recent reports from large municipal hospitals where cases of bowel obstruction are frequently seen indicate that from 35 to 60 per cent of patients operated upon for acute bowel obstruction die (Miller). Despite the fact that marked improvement is manifest in the results of practically all other acute abdominal catastrophes, the mortality of obstruction to-day is almost that of forty years ago. This is due in large measure to late diagnosis, for any number of statistical studies indicate that when cases come to operation early the results compare fairly satisfactorily with the issue attending the surgery of other acute abdominal disorders.

Finney reports a mortality of 36 per cent in 217 cases, but within the first 12 hours the mortality was 5 per cent and for the 12-to-24-hour period, 11 per cent. Whereas the mortality in the entire group of 128 cases of acute intestinal obstruction reported by Tuttle was 41.3 per cent, in 13 cases operated upon within 6 hours there were no deaths and in the 25 patients operated upon within 12 hours the mortality was 4 per cent. In 124 cases reported by Brill the mortality for the group was 36.3 per cent, but of the 17 cases operated upon within the first 12 hours there were no deaths, and of 16 cases operated upon between 12 and 24 hours, 12.5 per cent died.

DIAGNOSTIC FEATURES OF OBSTRUCTION

The criteria upon which the diagnosis of

intestinal obstruction is usually made are the following: Pain, nausea and vomiting, obstipation, meteorism, and collapse. All of these symptoms may be observed at some time during the course of obstruction, but usually at not sufficiently early an hour to afford the patient early remedial help.

DIFFICULTIES IN DIAGNOSIS

Absence of Local Physical Findings.—

There are two factors, I believe, which are largely responsible for the difficulty in making the diagnosis. One of these is the absence of local physical findings in acute bowel obstruction. When obstruction of the strangulating variety is present, local physical findings are usually in evidence; when, however, only the continuity of the bowel is obstructed without vitiation of the blood supply of the intestine, early physical findings are absent. In all other acute abdominal disasters rigidity and tenderness occur early, suggestive of the presence of a serious lesion within. Were acute cases of appendicitis not heralded by the presence of tenderness or rigidity, undoubtedly a larger number would come to operation when peritonitis had already supervened. The very fact, however, that acute intestinal obstruction is the only serious abdominal disorder of an acute nature in which physical findings are absent early is of great importance. When a patient complains of intermittent, crampy, colicky pain, nausea and vomiting, but local physical signs are absent, the presence of bowel obstruction should immediately be accorded serious consideration. Patients with strangulated external hernias are, in every

¹Presented before the Minnesota Radiological Society, Oct. 25, 1930.



Fig 5-A Gaseous distention in a case of suspected intestinal obstruction. It is not clear whether the gaseous shadow on the left is dilated small intestine or whether it is colon.



Fig 5-B The same after the rectal administration of barium. The gaseous distention is distinctly seen to concern the small intestine.

A patient had convalesced nicely following the removal of an acutely inflamed appendix and an ovarian cyst encountered incidentally. About a week later she complained of unusually severe "gas pains," which were attended with vomiting. A mechanical adhesive type of obstruction was suspected, but when the ingestion of castor oil failed to aggravate the pain and was followed by the evacuation of small amounts of gas and feces, and enemas proved equally as efficacious, it was felt that no interruption to the continuity of the bowel existed. Only after several days, when distention gradually increased and the vomiting became regurgitant in character, was it appreciated that a partial obstruction was becoming impassable.

That it is decidedly unsafe to continue the expectant treatment in incomplete obstructions of an acute nature is a matter of com-

mon knowledge among surgeons of experience. Somewhat more than five years ago I had the humiliating experience of losing a patient through the belief that a partial obstruction was well tolerated. A mechanical obstruction developed in a young boy of 8 years, five days following an operation for diffuse peritonitis having its origin in a ruptured appendix. The boy, whose condition was desperate, was operated upon rather hurriedly and several adjacent loops of the ileum were found adherent to the anterior abdominal wall. These attachments were separated, but four intestinal fistulas developed in the loops adherent to the abdominal wall. Some months later, the segment of intestine concerned was excised and an intestinal anastomosis made. The immediate convalescence was without untoward event, but slight vomiting and intestinal distention

the point of obstruction is, therefore, physiologically as well as anatomically normal. Why should not the patient with bowel obstruction expel gas? Only when the obstruction is low down and complete will no

mitigate against the presence of bowel obstruction.

Distention is a late occurrence in acute intestinal obstruction, and regurgitant vomit-



Fig 3 Gaseous distention of small intestine in dog 4½ hours after the small intestine had been obstructed in the lower ileum



Fig 4 Gaseous distention in a case of peritonitis. The relatively thick intestinal walls between the dilated loops suggest the presence of exudate between them. The peritonitis had its origin in a suppurative appendicitis for which the patient was successfully operated upon

gas be obtained when an enema is given, and undoubtedly on the first administration of an enema gas may be obtained

It is, of course, a good plan to give enemas when a patient is suspected of having obstruction, and I like to observe the following plan in their administration. An enema, preferably a soap-suds enema, is first administered and a responsible attendant is present to evaluate the expulsion. Should the patient expel gas, and pain continue, another enema is administered after 20 or 30 minutes. If gas is expelled but pain continues, and the other signs point to an obstruction, operation is urgently indicated. The evacuation of gas and feces does not

ing, significant of the presence of a blocked bowel, is, of course, a late sign. The vomiting which occurs early in intestinal obstruction is of a reflex character, much as that observed in gallstone or kidney colic or in acute appendicitis

Mistrust in Apparently Effectual Catharsis—Occasionally one hears the oral administration of a vigorous laxative such as castor oil vaunted as an important aid in determining the necessity for operation in bowel obstruction. Just recently the unreliable information obtained through this practice in suspected obstruction came to my attention

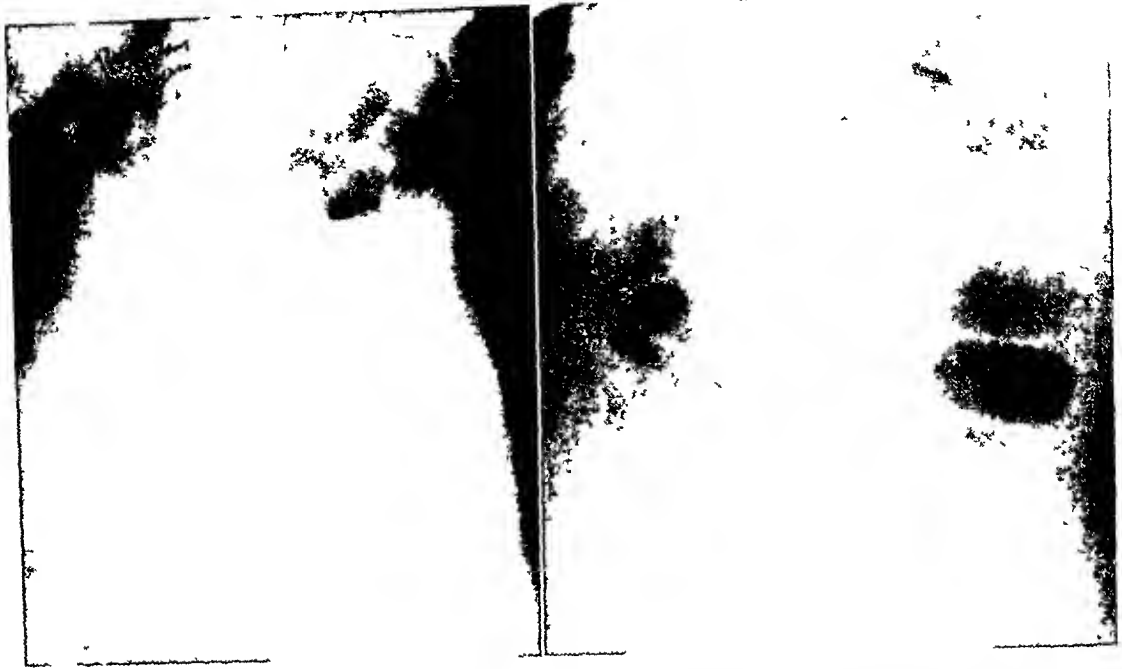


Fig 7-A Visible gas in small intestine and colon in a boy with suspected bowel obstruction

Fig 7-B The same, three hours later, indicating the progression of distention of the small intestine and the necessity for immediate operation

ature The leukocyte count is not elevated except when vomiting has been present for some time, when a definite leukocytosis usually obtains. Alteration in the blood chemistry values, *viz* elevation of the blood urea, depletion of the chlorides, and an alkalosis, are, even in high obstructions, late signs of the disease and occur usually only after forty-eight hours. In low obstruction, they are frequently absent at any time. Altered values should therefore not be awaited before a diagnosis of intestinal obstruction is made.

Danger of Morphine—A serious evil in the management of all acute abdominal disorders is the administration of morphine before the diagnosis has been made. Frequently both patient and physician are pleasantly lulled into a sense of temporary security by this disguise and the significant sentinel warning of intermittent colicky pain is silenced until physician and patient are apprized by the increasing distention, regurgitant overflow vomiting, and other sin-

ister warnings that bowel obstruction is present, but, alas too often, too late to undo the harm wrought by the irremediable delay. Even following the administration of morphine, however, loud intestinal borborygmi may be heard over the abdomen significant of the abnormal peristaltic activity of the intestine (5).

The Stethoscope.—A much neglected criterion of physical examination in all cases of abdominal disorders of an acute nature is stethoscopic examination. When the abdomen is auscultated in the presence of a mechanical obstruction, loud intestinal noises coincident with the height of the pain are heard. These are frequently of an explosive character. Normally, intestinal noises may be heard in the abdomen. A metallic tinkle, when heard over the abdomen, indicates the presence of bowel that is dilated and already under tension. When sounds much like those occasioned by the dropping of water in a rain-barrel or caused by inverting a bottle and allowing the water to



Fig. 6-A. Radiograph of abdomen of a child with a gangrenous loop 18 inches in length in the mid-abdomen. Gaseous shadows are visible in the left and right upper quadrants of the abdomen. No visible gas in the small intestine where the gangrenous bowel was found at operation.

Fig. 6-B The same, in the standing posture

persisted. Unfortunately, too much emphasis was put upon the evacuation of a stool following the oral administration of castor oil and the appearance of ingested charcoal in the feces. The unfortunate lad died twelve days after the establishment of the continuity of his intestine from a partial obstruction. The night before, an explosive-like expulsion of gas and feces had been obtained following the administration of pituitary extract. A postmortem examination indicated that a secondary enterostomy would have replaced failure by success. To-day when operating for the closure of small intestinal fistulas, if the slightest doubt exists

concerning the unobstructed continuity of the intestine below the fistula, I always perform an enterostomy above the intestinal anastomosis. It serves as an adequate safety vent, and, if clamped for a few days before removal of the catheter, reliable information is obtained concerning the continuity of the distal intestine. The administration of castor oil is not a satisfactory guide in the diagnosis of acute bowel obstruction nor is the expulsion of gas a reliable index as to whether or not operation is indicated. Persistence of pain indicates continuance of the obstruction.

Early in intestinal obstruction there is no change in the patient's general condition. The pulse is not quickened, and there is usually no disturbance of the body temper-



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Fig. 8-A. Distention of small intestine in a patient with pelvic inflammatory disease. At operation a mechanical obstruction to the continuity of the bowel was also seen. Gallstones are also visible on the film.

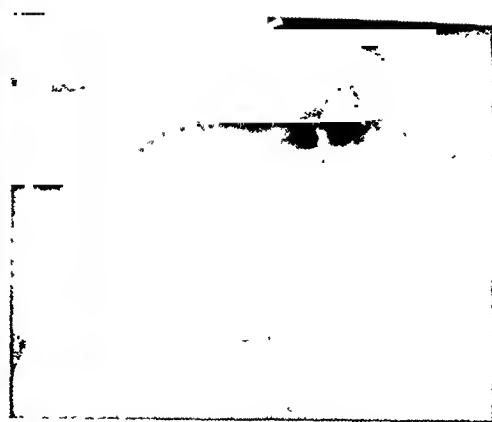


Fig. 8-B. The same, in the lateral posture, showing fluid mirrors.

run out are heard over the abdomen in a patient complaining of colicky pain of an intermittent nature, it is very likely that an obstruction is present. Fluid and air are carried downward together by the peristaltic rushes in the intestine, and, as the obstruction is reached, fluid and air separate, giving rise to the gurgling noises. Intermittent, crampy pain not attended by local physical findings, but accompanied by loud, gurgling noises heard with a stethoscope over the abdomen, with maximum intensity at the height of the pain, is highly suggestive of acute obstruction of the intestine. The abdomen of peritonitis presents the "stillness of the grave." Visible peristalses, though pathognomonic of the presence of bowel obstruction, in the presence of a normal abdominal wall in my experience are rarely seen in acute obstruction, whereas, in obstructions of a sub-acute or chronic nature, they are practically always observed.

On one occasion in a patient with a ruptured tubal pregnancy and considerable blood in the peritoneal cavity, exhibiting on an X-ray film gaseous distention of both large and small intestines, I have heard a few intestinal gurgles, but the absence of pain of an intermittent, crampy nature at the time that the intestinal noises were heard, as well as the local physical findings, served to eliminate the possibility of intestinal obstruction. In a few instances of peritonitis the abdomen is not absolutely silent.

In mechanical bowel obstruction occasionally, but much more frequently in the paralytic ileus of peritonitis, the heart and breath sounds may be transmitted over the abdomen. Fluid and gas in the bowel and fluid between the intestinal coils constitute a splendid medium for transmission of the sounds from the thoracic cavity.

X-RAY EVIDENCE

It has long been recognized that the X-ray is of value in detecting bowel obstruction, but this agent has not been accorded the importance it deserves in the diagnosis of acute intestinal obstruction. As long ago as 1911, Schwarz, of Vienna, described the presence of gaseous shadows in the small bowel, and indicated their significance in the diagnosis of acute bowel obstruction. He, however, was unwilling to commit himself to the diag-

nosis unless corroborative evidence was obtained by the administration of an opaque contrast medium. In 1914, Case described the significance of these gaseous shadows for the presence of bowel obstruction, and has since been insistent in emphasizing the value of this aid in diagnosis. Kloiber was the first, in 1919, to indicate that the diagnosis of bowel obstruction could be made on the presence of these gaseous shadows in the small intestine alone, and stated that the administration of barium was not necessary.

It is well known that when a plate is made of the abdomen of the adult, gaseous shadows are observed in the stomach and colon. Gas is also present throughout the small intestine, but the intimate admixture of gas and fluid in the small bowel precludes the distinguishing of gas from its immediate surroundings. The demonstration of gas in the small intestines on the X-ray film is, therefore, decidedly abnormal and is indicative of the presence of a mechanism interfering with the normal rapid rate of transit through the small intestines. The "ladder pattern," described by Case as a typical picture of bowel obstruction, need not be awaited to make the diagnosis (Fig. 2). Visible collections of gas in the small intestines of the adult are synonymous with intestinal stasis.²

In the experimental laboratory it has been found that definite X-ray evidence by the single plate method may be obtained within four or five hours after the establishment of simple obstruction in the small intestine (20) (Fig. 3). When the obstruction was established in the descending colon, the time of appearance of gaseous shadows in the small intestine was a variable factor, and was usually not observed earlier than from eight to ten hours. A few cases of malignancy in the pelvic colon causing acute obstruction have come to my attention in which no gaseous shadows were visible in the small in-

testine, despite enormous distention of the colon, and I have gained the impression that in a patient with acute bowel obstruction, suspected of having a malignancy in the colon, absence of gaseous distention of the small



Fig 9 Radiograph of abdomen of a patient, aged 24, with considerable intestinal distention. She had been operated upon twice previously and presented all the findings of a mechanical obstruction. The distention is confined largely to the colon, however, suggestive of the presence of functional spastic ileus. A cecostomy was done because of the great distention and continued vomiting.

intestine strongly favors a carcinoma of the sigmoid, rather than a lesion in the right half of the colon.

In taking the film, it is a good plan to make an exposure in the standing posture as well as with the patient prone or supine. In this position gas is visualized over fluid, giving the appearance of fluid mirrors. If the patient is too ill to stand, he may be turned on his side and fluid levels may as easily be demonstrated as when he is erect. A single plate taken with the patient prone or supine,

²Gas is regularly visualized in the abdomen of the infant up until past two years of age.



Fig 10-A Radiograph of newborn with intestinal atresia. The gaseous distention of the small intestine is apparent.

Fig 10-B. The same, in the erect posture.

Fig 10-C. After the oral administration of a little barium and barium by rectum.

however, gives all the necessary information, and the degree of intestinal distention is best determined from such a film. The oral administration of barium is to be deprecated in all cases of acute intestinal obstruction for the diagnosis can be made without it. Frequently, in instances of acute intestinal obstruction, when given it fails to leave the stomach and oftentimes takes considerable time before the barium goes down far enough in the small intestine to be of any value in locating the point of obstruction. It is far safer to locate and determine the nature of the obstruction at operation, at which time it can be done with much less risk to the patient.

The determination of whether the visualized gas is in the large or small bowel is occasionally a difficult matter. Gas in the small intestine is characterized by its central location; the long axis of the shadow is transverse, and when the loops are considerably dilated the two intestinal walls separating adjacent loops are seen as a very thin and narrow wall. The occurrence of a fairly thick wall separating greatly distended

loops should suggest the presence of fluid or exudate between the loops (Fig. 4). Gas at the lateral borders of the abdomen is ordinarily in the colon; the long axis is usually vertical, and the intestinal walls are thicker and haustral markings are occasionally in evidence. On one occasion a small barium enema was given to differentiate whether the gas was in the colon or small intestine (Fig. 5). The administration of a little barium by mouth for the same purpose would appear to be justifiable, but as yet we have not found it necessary to have recourse to such a measure. The typical appearance of the gaseous shadows in the obstructed small intestine may be described as a stepladder arrangement of the coils; the mucous folds of Kerkring within the bowel lend a feathery appearance. However, it must be emphasized that this stepladder-like arrangement is not necessary to make the diagnosis. Visible gas in the small intestine of the adult is synonymous with intestinal stasis.

The stethoscope serves to distinguish the type of intestinal stasis. When mechanical in nature the occurrence of intermittent,

crampy, colicky pains, associated with loud intestinal borborygmi, establishes the obstruction as mechanical interference with the continuity of the intestine. If, however, gas is distributed throughout the colon as well, and the abdomen is silent on auscultation, it is almost a certainty that the obstruction is paralytic in character.

How many lives would be saved by the more frequent employment and judicious use of these two simple agents—the stethoscope and the X-ray! In many instances the diagnosis can be made over the telephone. The story of a previous operation, with the occurrence of intermittent colicky pain attended with nausea and vomiting, but no local tenderness or rigidity, are as suggestive of bowel obstruction as the “pain, food, relief” sequence in duodenal ulcer. The verdict of the X-ray and the auscultatory examination of the abdomen determine whether or not intestinal stasis is present, and whether it is mechanical or inhibitive (paralytic) in character.

In the trying situations that occur in the immediate convalescence after operation, when it is debated whether a paralytic ileus or an adhesive obstruction is present, these criteria are equally as dependable. Post-operative obstruction due to adhesions invariably concerns the small intestine. X-ray examination in its presence reveals gaseous shadows in the small intestine, with an empty colon. The stethoscope indicates the mechanical nature of the obstruction. Paralytic ileus would be heralded by a uniform distention of the colon and the small intestine on the X-ray film, and a death-like silence on stethoscopic examination of the abdomen.

There are, unfortunately, a few instances in which the differential diagnosis may be exceedingly difficult. Occasionally a paralytic type of obstruction fails to cause a general distention of the entire intestinal tract, causing, instead, dilatation of only a few coils of the small intestine. In the event

that faint gurgling sounds can be elicited with the stethoscope, the diagnosis is especially difficult. The presence or absence of intermittent pain is significant. In inter-



Fig. 11 Radiograph of new-born with intestinal atresia at the point of juncture of first and second portions of the duodenum. The bile duct emptied into the distal segment of the duodenum and the meconium was green in color. No gas in the small intestine.

rogating patients with suspected post-operative obstruction it is always essential to converse with them in their own language. I have several times been informed by such a patient that he has no pain, but when inquiry is made as to whether he has suffered from “gas pains,” a voluble confession of such distress has been obtained. In borderline cases, evidence obtained from X-ray films spaced a few hours apart, as outlined below, is of great help (Fig. 7).

When strangulating types of obstruction were established in the laboratory, however, the gaseous shadows did not appear with such regularity as when simple obstructions were made (2, 8). In every strangulating obstruction a simple obstruction is also present above the strangulation; in order to obviate the confusion of this factor, seg-



Fig. 12-A Gaseous distention of the abdomen in an infant with intestinal atresia.



Fig. 12-B The same, with the infant held up by the legs in the inverted posture. The ease with which the bowel may be reached surgically is apparent.

mental obstructions were made by isolating a segment of the intestine and inverting the ends; the continuity of the remainder of the intestinal canal was re-established. Such an isolated segment, especially in the upper intestine, constitutes a true strangulation obstruction, for continued secretion in excess of absorption produces distention ulcers on the antemesenteric border of the intestine and finally rupture may occur. In such instances gaseous shadows were rarely observed early in the isolated loop. More recently, comparative studies have been made on the quantity of gas accumulating in the bowel in simple, closed loop, and strangulation obstructions (*Proc. Soc. Exper. Med.*, in press). It was found that gas accumulated in far greater amounts in the proximal bowel in simple obstruction to its continuity

Gas formation within a closed or strangulated loop was found to be an inconstant feature.

It has been a matter of general opinion that the strangulation obstruction presented a distended infarcted coil of bowel that could frequently be percussed out as a tympanic mass as well as palpated through the abdomen walls. Wahl long ago called attention to this phenomenon occurring in volvulus of the sigmoid flexure and the sign has since been known as "Darmsteifung" (stiffening of the bowel). Undoubtedly, however, the mechanical interference with the continuity of the intestine rather than the deprivation of blood supply to the bowel (strangulation features) are responsible for this phenomenon. That the gaseous shadows in the small intestine in strangulating varieties of ob-



Fig 13-A Another infant with intestinal atresia held in the inverted posture. There is a lead disc over the perineal dimple. The rectum appears to be intrapelvic.

Fig 13-B The same, a few hours later, made in the same position. A slight pressure is being made over the anal dimple with a clinical thermometer. The rationale of approaching the lesion from below is indicated by the radiogram.

struction do not appear as early or as regularly as in simple obstruction merits emphasis.

The accompanying radiograph (Fig 6), made from a boy of 8 years, with an intestinal obstruction of 80 hours, illustrates this in part. The visible gaseous shadows in the small intestine represent the distended proximal intestine. A gangrenous mass of small intestine about 18 inches in length occupied the central portion of the abdomen, where no gaseous shadow is visible on the film. Without exception, the instances of simple obstruction that have come to my attention, with an obstruction of as long standing as in this instance, have presented a continuity of "ladder patterns" in the small intestine when the exposure was made with the patient prone.

In simple obstruction visible gas accumulates early, directly above the point of

obstruction. In strangulation obstructions, the bowel wall proximal to the infarcted coil is also somewhat hemorrhagic, and I have once come to grief in the resection of a strangulated bowel because of not excising sufficiently the hemorrhagic but viable bowel before making the anastomosis. In the instance of the boy referred to above, no primary anastomosis was made, but an exteriorization performed much as one does a Mikulicz operation for cancer of the sigmoid flexure. Only when the hazard of the obstruction had been survived was the continuity of the bowel re-established. As has been stated above, a simple obstruction is present immediately above every clinical strangulation obstruction, but why the gas fails to accumulate there or to become visible early on the X-ray film is not apparent. The altered state of the bowel proximal to the infarcted loop probably affords a partial ex-

planation. Fortunately, patients with this type of obstruction usually exhibit local physical findings and complain of intermittent colicky pain, at the height of which exaggerated activity of the proximal intestine may be elicited with the stethoscope. These findings suffice to make the diagnosis of bowel obstruction and indicate the necessity for immediate operation.

Attempts were made also to determine the reliability of the appearance of gaseous shadows in other types of intestinal stasis, *vis.*: interference with the portal or mesenteric veins and in peritonitis (2). Even though gaseous shadows in the small intestine were occasionally seen after ligation of the mesenteric or portal veins, visible gas in the small intestine did not regularly appear early. In peritonitis and in simple obstruction, gaseous shadows in the small intestine are an early occurrence.

The employment of the X-ray to determine the degree of intestinal distention has often proved of great value. In the instance of a boy admitted some weeks after appendectomy, because of occasional cramps and vomiting, it served to indicate the necessity for operation. This boy had complained of pain for about twenty-four hours, but had only one fairly severe pain after admission to the hospital. After being observed over a period of several hours, auscultation at the height of that crampy pain revealed the presence of loud intestinal noises. Three hours later, when another plate was made of the abdomen during which interval no pain had been complained of, and only occasional rumbles were heard with the stethoscope, it was observed that a marked progression in intestinal distention had obtained (Fig. 7). This served as adequate indication for immediate operation. When the abdomen was opened several coils of small intestine were found adherent in a loop-like arrangement, and they had formed a volvulus which in the course of a few hours

would have progressed to a strangulation obstruction. A gas trap was formed, such that gas and fluid easily came in, but after a while neither escaped, due to the continued secretion of the incarcerated bowel which became more and more distended. The infrequency of the colics was undoubtedly due to the fact that the obstruction was only partial in character.

In a recent case of a patient with pelvic inflammatory disease, the X-ray evidence was of great aid in evaluating the findings and the history. The patient had complained of severe pain over the abdomen for some considerable period of time. There had also been a recent acute gall-bladder attack. When the patient presented herself at the University Hospital about three weeks after the onset of the distention, she complained of recurrent, intermittent, crampy abdominal pain, associated with vomiting. A mass was palpable in the pelvis and diffuse peritoneal irritation was present everywhere. The X-ray indicated the presence of gaseous distention of the small intestine (Fig. 8), and when the abdomen was auscultated at the height of the pain intestinal noises were heard, significant of the concomitant presence of bowel obstruction.

FUNCTIONAL SPASTIC ILEUS WITHOUT MECHANICAL OBSTRUCTION

There is a small group of cases that present all the symptoms of a mechanical obstruction of an acute nature but in which, at operation, no interference with the continuity of the bowel can be demonstrated. Seven such cases have come to my attention. They complain of intermittent crampy pain, exhibit nausea and vomiting, and usually considerable distention at the lateral borders of the abdomen but no tenderness or rigidity of the abdominal walls. At the height of the colics loud gurgling intestinal noises may be heard throughout the abdomen: small accumulations of gas may occasionally be made out in the small intestine, but the colon

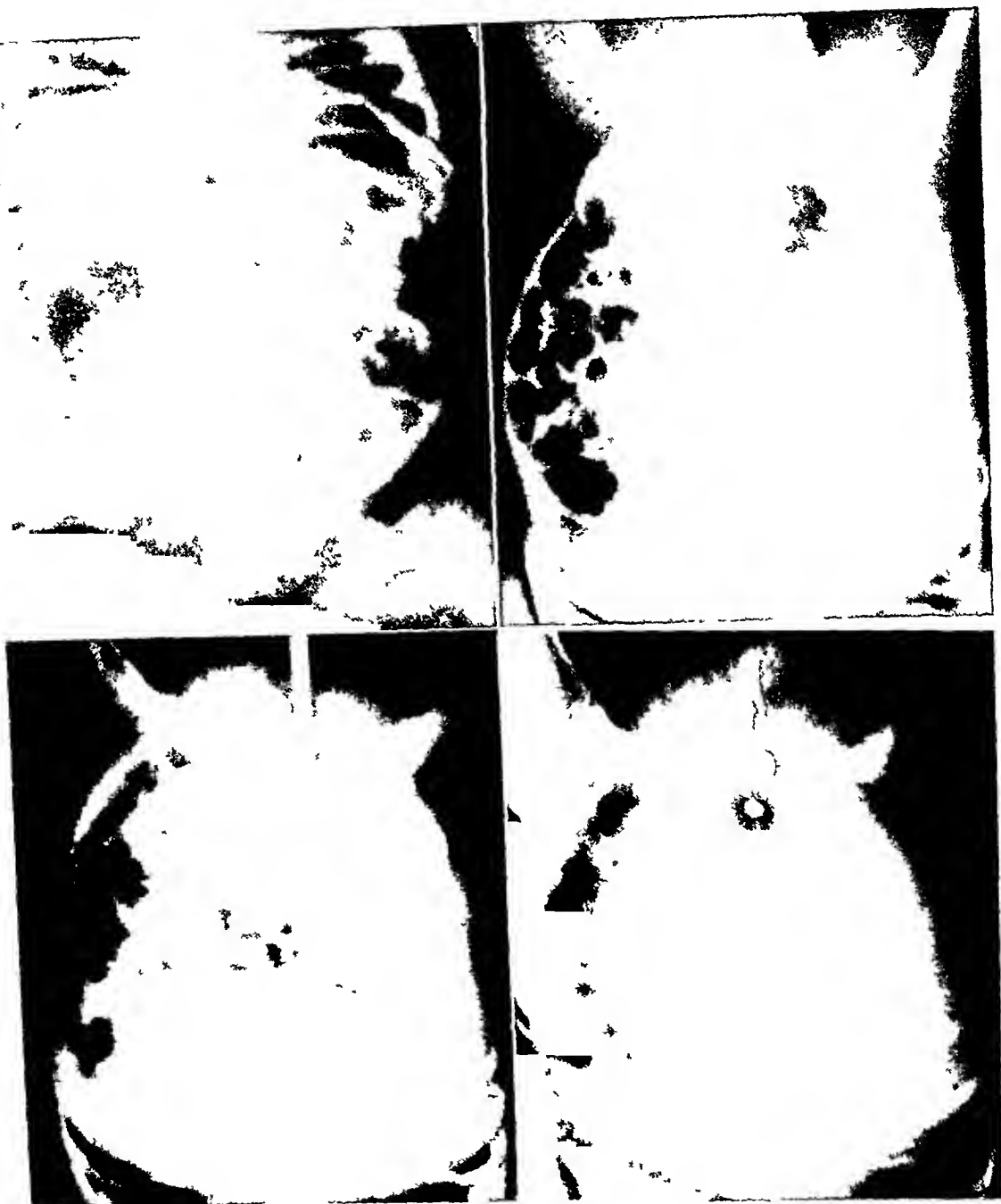


Fig 14-A (Upper left) Infant with imperforate anus, plate taken with the child supine

Fig 14-B (Upper right) The same, in the inverted posture

Fig 14-C (Lower left) A clinical thermometer exerts slight pressure over the anal dimple. As this was done a slight amount of gas escaped and the rectal dilatation visible in 14-B disappeared

Fig 14-D (Lower right) After the injection of a few cubic centimeters of lipiodol, a fistulous tract communicated with the rectal ampulla, dilatation relieved the condition

is invariably enormously distended, and considerable gas is usually observed in the stomach. On the administration of enemas,

gas in small amounts is evacuated but without affording relief.

In what the essential disturbance consists



Fig. 15-A. Defect in the cecum in a male infant of 7 months, with a palpable tumor and blood in the stool (ileocecal intussusception).



Fig. 15-B The same, after effective reduction with a barium enema under the fluoroscope.

is not apparent, but for want of more accurate knowledge concerning the obstructive phenomena in this condition the term "spastic ileus" may perhaps be well applied. Most of these patients have a functional bowel disturbance in which constipation is a prominent factor. I have looked upon the condition as one in which the small intestine is normally active and propels its content into a feebly acting colon that behaves like a large reservoir, the latter constituting a passive resistance or obstruction. That this postulate is not strictly true I have found by passing a balloon into the colon of such a patient and noting its normal reaction to drugs that stimulate the bowel wall.

In all particulars, however, these cases simulate a mechanical obstruction in the bowel. The roentgen findings, however, furnish an important clue by which the condition may be recognized, when the clinical and X-ray findings are jointly considered (Fig. 9). The marked distention of the entire colon, with colicky pain and loud borborygmi,

speaks for a low obstruction. If a carcinoma of the pelvic colon can be reasonably excluded, a spastic ileus of the type described here is to be strongly considered. In case of doubt a barium enema would give unequivocal information as to whether or not an organic obstruction was present in the colon.

Fortunately these cases are rare. When the condition is identified, conservative measures may be given a reasonable trial before resort is had to operation. The first patients presenting this type of obstruction that came under my care were all operated upon. Latterly the gaseous distention of colon and stomach, with slight or no gas visible in the small intestine, has given me courage not to operate, despite the presence of intermittent pain and gurgling noises suggestive of a mechanical obstruction. A patient with six operative scars on her abdomen from previous laparotomies for obstruction, I have conservatively watched through two bouts of marked distention, fortified by

the confidence the X-ray affords in recognition of this syndrome. Despite the absence of organic obstruction, in the presence of an actively motile upper intestine a decompression (cecostomy) must occasionally be done and I have once felt constrained because of the enormous distention of the cecum to perform a cecostomy despite correct pre-operative recognition of the condition, in fear that the cecum might perforate. Recurrences of the trouble are not infrequent and I prefer to leave such a patient, if operation is necessary, with an appendicostomy to serve as a safety vent through which a catheter may be passed in the day of trouble.

Accompanying multiple fractures of the lower ribs as well as in a few acute abdominal lesions as appendicitis, acute gall-bladder attacks, and renal colic, clinical distention occasionally occurs and it is observed that gas is visible in the small intestine. Here, however, the stethoscope serves as an adequate differential. In the gaseous distention accompanying these disorders the dilatation of the intestine is usually inhibitive in character and loud intestinal borborygmi at the height of the pain are absent. The occurrence of local physical findings serves also to identify the conditions just enumerated.

SPECIAL USES OF THE X-RAY

There are a few special conditions in which I should like to indicate the use that we have made of the X-ray in making the diagnosis of bowel obstruction. One of these is intestinal atresia. The obstruction is usually in the ileum, duodenum, or jejunum, and occasionally in the colon. In 15 per cent of such cases, however, the obstruction is multiple. In these instances it is usually a good plan to give some barium by mouth to make certain that the barium leaves the stomach. It has also been our plan to give a little barium by rectum, to be certain that the colon is not atresic. It has been my privilege to operate upon two such instances,

but unfortunately neither patient recovered. On perusing the literature, however, I find that nine patients have made a satisfactory recovery following such an operation. In all instances an enteranastomosis was made. In no instance has an infant survived an enterostomy performed for the relief of intestinal atresia. The X-ray films of two such cases are reproduced here (Figs. 10 and 11).

In imperforate anus, the X-ray is an important agent in determining the degree of stenosis. Somewhat more than a year ago Rice and I had occasion to employ the X-ray in determining the degree of atresia in a patient who had an imperforate anus (Fig. 12). On holding the child upside down the gas ascends to the nearest point to which the bowel approaches the skin. It then becomes easily apparent how much of a surgical procedure is necessitated to establish communication with the skin. Not long afterward the opportunity was afforded to evaluate the worth of the method in another patient, in whom the X-ray indicated the difficulty but the feasibility of decompressing the atresic bowel from the perineum (Fig. 13). In a recent patient with imperforate anus the nature of the defect was disclosed and the type of procedure necessary for its relief indicated (Fig. 14).

There is another condition in which the X-rays are of value not only in determining the type of obstruction but also in therapy. I refer to intussusception. A few physicians have employed the single plate of the abdomen in the diagnosis of intussusception alone. Our experience, however, is that the diagnosis of intussusception can usually be made clinically by the presence of intermittent, crampy, colicky pains and the presence of a tumor. Intussusception usually concerns infants, especially of the male sex. It occurs between the fifth and ninth months of life in 50 per cent of the instances. The occurrence of intussusception in a child more than two years of age should arouse suspicion of the

likely presence of a tumor within the bowel or a Meckel's diverticulum. In the instances in which it has been my privilege to operate for intussusception in older children or adults, a polyp, carcinoma, or a Meckel's di-

tussusception, a large number of which he was able to reduce by the non-operative method. The best results to date that have come to my attention in the treatment of intussusception have been those reported by

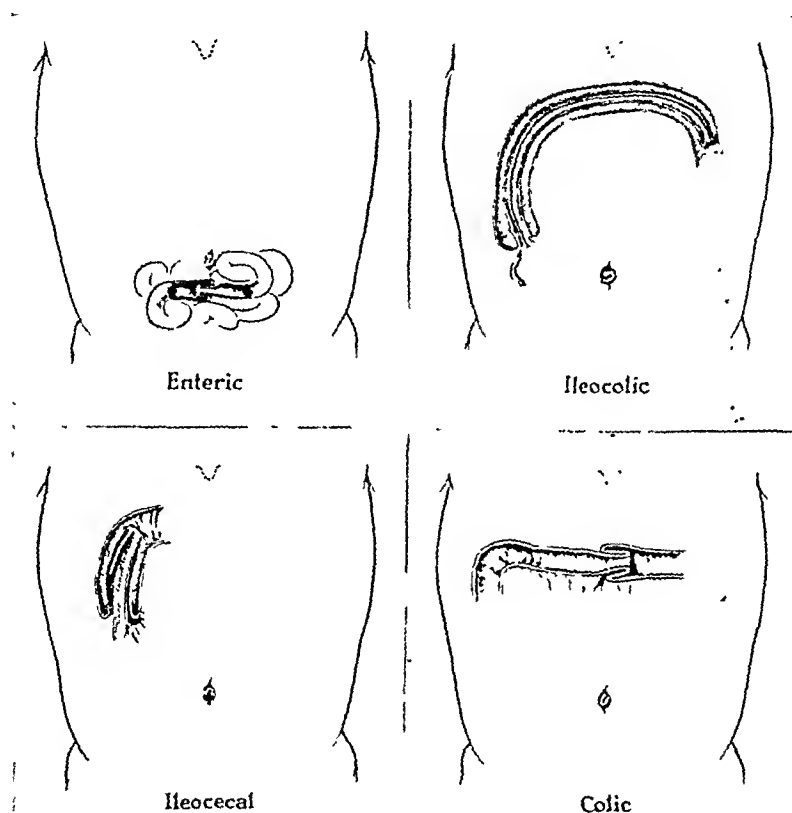


Fig. 16. Schematic drawings of the various types of intussusception. Reduction by means detailed here is likely of accomplishment in early invaginations of the ileocecal or colicocolic types.

verticulum has usually been found. Eliot and Corscaden found in 300 instances of intussusception in adults that in 100 cases tumor or a Meckel's diverticulum was responsible for the intussusception.

A number of years ago Hirschsprung advised a non-operative method of reduction of intussusception and practised it with good results. His successor, Professor Monrad, at the Queen Louise Hospital in Copenhagen, reported recently 115 cases of in-

Hipsley, of Australia, in 1918. He reported 51 successful operative interventions for intussusception. In 1926 Hipsley wrote that he had become familiar with Hirschsprung's method and had used it in more than 100 cases with good results. He did not employ Hirschsprung's method of abdominal taxis under anesthesia, but allowed water to run into the colon under the influence of 3.5 feet gravity pressure. Hipsley stated that the results by the conservative method were so

good that he would be unwilling to submit a patient to operation for intussusception until the conservative means of reduction had been employed.

The Achilles' heel of the method as recommended by Hirschsprung is that there is no way of telling whether the intussusception has been adequately reduced until a spontaneous evacuation of feces occurs. Occasionally a considerable period of time intervenes until reliable evidence is obtained by this means, and in the event the intussusception has not been completely reduced, valuable time has been lost. Olsson and Pallin, from Key's clinic in Stockholm, a few years ago suggested the use of barium to determine whether or not the reduction had been effective. This is the manner in which we have used it. The accompanying illustration indicates its use (Fig. 15). A column of barium at a level of about three and a half or four feet should be used with gravity pressure only. The barium indicates the defect and at the same time affords a visual test of whether or not the reduction is complete.

The only invaginations that are likely of reduction by this method are the ileocecal and colicocolic. The ileocolic invagination is not easily reduced by this method, and it is, of course, of no value in enteric intussusception. A case of ileocolic intussusception in which the apex of the intussusception protruded at the anus has come under my observation in which the use of barium as described above pushed back the small intestine for a considerable distance, but operation was necessary to complete the reduction. About 70 per cent of invaginations in children are of the ileocecal variety in which the method should be effective if the child is seen early. In late cases in which an intimate adherence between invaginated and ensheathing layers has occurred, due to infarction of portions of the bowel, the method is not likely to be successful. When the method is

ineffectual operation should be performed at once.

SUMMARY

The present high mortality in acute intestinal obstruction is due in large measure to late diagnosis. Revision of the usual criteria upon which the diagnosis of bowel obstruction is made is urgently indicated. Obstipation, regurgitant vomiting, and general abdominal distention portend the beginning of the end of life for the unfortunate sufferer with bowel obstruction. These must cease to be occurrences awaited before the diagnosis is made.

Intermittent, crampy, colicky pain associated with nausea and vomiting but unattended by local physical findings suggests acute intestinal obstruction. The bowel below the point of obstruction is physiologically as well as anatomically normal and will expel an administered enema, with the return of gas and feces. Gaseous shadows in the small intestine demonstrate the presence of intestinal stasis. The "ladder pattern" of gaseous distention in the small intestine need not be awaited to make the diagnosis. The stethoscope serves to distinguish whether the stasis is mechanical or paralytic in character. When the diagnosis is made early the mortality of operation for acute intestinal obstruction will exhibit a like improvement to that long ago manifest in the surgery of most other acute abdominal catastrophes.

In simple obstruction to the continuity of the small intestine gas may be visualized in the small intestine usually within four or five hours after the onset of symptoms. When the obstruction is in the colon a variable time may elapse before gaseous distention of the small intestine becomes visible on the X-ray film. In strangulation obstructions gaseous shadows in the small intestine do not appear as early as in simple obstructions and this criterion is, therefore, not as reliable an index as in the latter type

of bowel occlusion. In vascular occlusions of the mesenteric vessels, gaseous distention does not occur as early as in simple obstruction. In the inhibitive ileus of peritonitis, gaseous distention of the small intestine may be observed early. Gaseous distention of both colon and small intestine is almost invariably present. The presence of dense "bands" between the dilated intestinal loops suggests the presence of exudate between the intestinal coils.

The entity of functional spastic ileus which simulates mechanical obstruction in all clinical features may be identified by proper correlation of clinical and roentgen findings. The special uses of X-ray evidence of obstruction are enumerated for intestinal atresia, imperforate anus, and intussusception. In the latter condition the barium enema may frequently be employed to reduce the invagination.

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THE OSSEOUS CHANGES IN HYPERPARATHYROIDISM ASSOCIATED WITH PARATHYROID TUMOR: A ROENTGENOLOGIC STUDY¹

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ERDHEIM first pointed out the significance of the parathyroid glands in relation to metabolism of calcium in the skeletal system. His observations of more or less marked increase in the parenchyma of the parathyroid glands in osteomalacia have since been confirmed by many observers, although his interpretation of this change as a form of compensatory hypertrophy has led to much discussion.

Verbitz, Langhans, and Kocher, in 1907, all reported association with a parathyroid tumor of multiple brown tumors of bone. Strada, in 1909, observed a woman, aged 54 years, with osteomalacia who had hyperplasia of the parathyroid glands. In three cases of senile osteomalacia, however, Strada observed that the parathyroid glands were normal. Bauer, in 1911, and Todyo, in 1912, found hyperplasia of the parathyroid glands in cases of osteomalacia and osteoporosis. Molineus, in 1913, found hyperplasia of the parathyroid glands accompanying three cases of osteomalacia with multiple brown tumors of the bone, multiple fractures, and infarctions. In the same year, Paltauf and Askanazy reported a case of parathyroid tumor associated with osteitis fibrosa, multiple brown tumors of bone, and formation of cysts.

Schlagenhauser, in 1915, observed a man, aged 43 years, with hypertrophy of the left parathyroid gland and marked osteitis fibrosa. Maresch, in 1916, reported the association of enlargement of the parathyroid glands with osteitis fibrosa cystica in one case, with osteomalacia in one case, and with



Fig. 1. Diffuse osteoporosis of hyperparathyroidism. The bones in general have a granular appearance, and those of the pelvis a striated appearance (Case 2)

multiple cystic lesions in several bones in one case. The parathyroid bodies were macroscopically hypertrophied in eight cases of senile osteomalacia and in twenty-eight cases of osteoporosis, but in five cases of osteitis deformans the changes in the parathyroid glands were less marked.

Günther, in 1922, stated that almost all patients who have multiple brown tumors of the bones also have tumorous enlargement of the parathyroid glands. In the same year, Strauch reported the case of a woman aged 27 years who had marked puerperal osteomalacia, and a large parathyroid tumor. Danisch, in 1925, could demonstrate parathyroid tumors in only two of twenty cases

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Fig 2 Diffuse osteoporosis of the skull revealing the miliary granular appearance characteristic of hyperparathyroidism. There is apparent thickening of the frontal bone, and a fuzzy, indistinct outline of the outer table of the skull (Case 2)



Fig 3 Miliary granular changes in the skull characteristic of hyperparathyroidism. The larger regions of decalcification simulate metastasis. There is thickening of the parietal bone and an indistinct outline of the outer table (Case 1)



Fig 4 Early osteoporosis of the pelvic bones in hyperparathyroidism. This should be compared with Figure 5 (Case 1)



Fig 5 Same case as that presented in Figure 4, three years and eleven months later, but before removal of the parathyroid tumor. There is marked osteoporosis, also cystic lesions in the right ilium and sacrum. The pelvis has become wedge-shaped, due to softening of bone and weight bearing.

of senile osteoporosis. Hoffheinz, in 1925, reviewed forty-five cases of enlargement of the parathyroid glands, in twenty-five of which there were skeletal changes, and in seventeen of these, osteofibrosis was present. Mandl, in 1925, was the first to report roentgenologic data before and after opera-

tion in a case of parathyroid tumor. Before operation, osteoporosis and a fibrous appearance of the bones were present. Four months after operation, increased calcification was observed.

Richardson, Aub, and Bauer, in 1929, reported the case of a man, aged 34 years, in

which roentgenograms disclosed generalized osteoporosis, with rather coarse bone trabeculae. Fractures had occurred and had healed normally. Two apparently normal

changes. Snapper, in 1929, reported that improvement was demonstrable roentgenographically after removal of a parathyroid adenoma in a case in which there was gen-



Fig. 6. Cystic lesion in right femur associated with hyperparathyroidism. There is a resemblance to giant-cell tumor and the report after biopsy was "giant-cell tumor"; 6-A, anteroposterior view; 6-B, lateral view (Case 1).

parathyroid glands were removed, but roentgenographic examination two years later showed that the calcium content of the bones had markedly increased.

Barr, Bulger, and Dixon, in 1929, reported the case of a woman, aged 56 years, in which the roentgenograms revealed irregular areas of rarefaction in the bones, and cystic expansion of the maxilla. After removal of a parathyroid tumor, there was evidence of increased retention of calcium and the cystic tumor of the maxilla diminished in size. Boyd, Milgram, and Stearns observed a case in which the roentgenograms disclosed generalized osteoporosis, with cysts in almost all bones. The calvarium presented a moth-eaten appearance and the diploë were indistinguishable. There was alteration in the angles of the femoral and humeral heads. Two months after removal of a parathyroid adenoma, there was no demonstrable improvement in the osseous

changes. Snapper, in 1929, reported that improvement was demonstrable roentgenographically after removal of a parathyroid adenoma in a case in which there was gen-

eralized osteoporosis with the formation of multiple bone cysts.

Compere, in 1930, reported that he could not demonstrate improvement as evidenced by roentgenograms five months after removal of a parathyroid adenoma; previously generalized osteoporosis had been found.

Our observations have been limited to two cases of hyperparathyroidism associated with tumor of the parathyroid glands. The clinical and surgical aspects of one of these cases, which will be called Case 1, have been reported in detail by Wilder, and the other case, which will be called Case 2, by Pemberton and Geddie. The roentgenograms of these cases have been reviewed in the light of our present knowledge of hyperparathyroidism, and we believe the roentgenographic changes are worthy of detailed consideration. A third case of hyperparathyroidism in which the osseous changes are even more marked than those of either of these cases

has not been included in this report because the presence of a parathyroid tumor has not as yet been confirmed by operation.

It is obvious, from a review of the literature, that the co-existence of changes in

perparathyroidism, and nowhere in the standard English and German textbooks on roentgenology have we found the osseous changes accompanying hyperparathyroidism presented.



Fig 7 Osteoporosis of hyperparathyroidism. There is an area of subperiosteal bone absorption and obliteration of the cortex on the mesial aspect of the tibia below the internal condyle (Case 2)

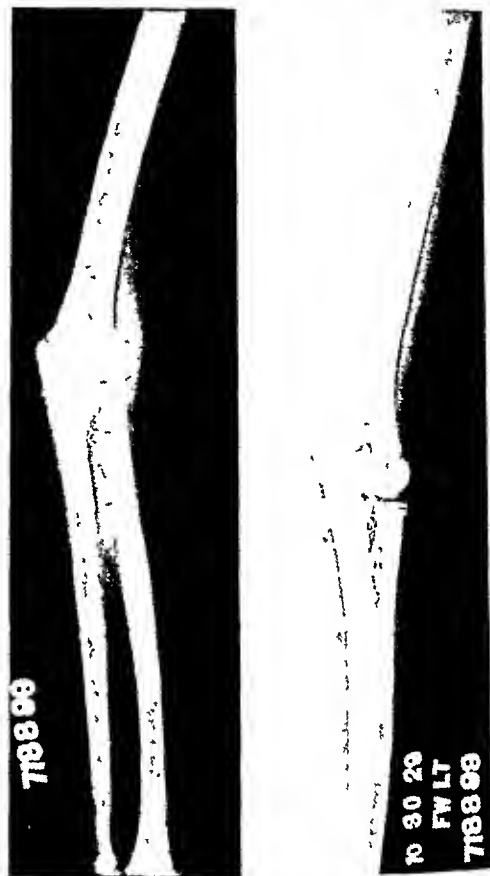


Fig 8 Osteoporosis of hyperparathyroidism. There are areas of subperiosteal bone absorption and obliteration of the cortex at the lower end of the radius and ulna, and also on the lateral aspect of the neck of the radius (Case 2)

bone and disease of the parathyroid glands has long been noted. In brief, the predominating osseous changes described are generalized atrophy of bone and cystic lesions. No attempt seems to have been made to regard certain changes as characteristic of hy-

It is noteworthy that when roentgenograms are compared in cases of hyperparathyroidism, the fundamental and predominating changes in bone are similar. The fundamental change observed seems to be decalcification, and this is revealed chiefly as uniform miliary and granular mottling. This peculiar type of mottled atrophy is dis-

tinct from the ordinary type of change seen in osteoporosis associated with acute and chronic disease of bone, or in neurotrophic conditions. In our experience there is no other generalized lesion of bone which exactly simulates the miliary mottling and granular appearance of the bone in hyperparathyroidism (Fig. 1) and we believe such an appearance to be characteristic of this condition. The change is best exhibited in flat bones, and especially in the skull (Figs. 2 and 3). In addition, the bone trabeculae become more delicate and indistinct, and the cortical bone is thinned. Because the bones are soft, bowing, kyphosis, narrowing of the pelvis (Figs. 4 and 5), and coxa vara may occur and produce noticeable diminution in stature. Deformities of the ribs may also occur and infractions of the long bones are not uncommon. In some regions the decalcification progresses to produce cyst-like lesions, and the jaw, pelvic bones, and femurs seem to be favorable sites for such changes. These lesions have been confounded with those of osteitis fibrosa and giant-cell tumor, and even biopsy of the cystic lesions frequently results in the diagnosis of giant-cell tumor (Figs. 6-A and 6-B). The presence of generalized osteoporosis, and the appearance of the miliary mottling in the skull should serve to distinguish hyperparathyroidism from osteofibrosis and from giant-cell tumor. In many instances the lesions are not accompanied by the expansion of the thin cortical bone that is seen in giant-cell tumor. In spite of the osteoporosis there appears to be some thickening of the bone in the frontal and parietal regions, although thickening has not been observed in other bones. Near the ends of the long bones, and in the phalanges, regions of subperiosteal absorption, with consequent obliteration of the cortex (Figs. 7 and 8) are seen.

The osseous changes have been confounded with those of metastatic carcinoma

and multiple myeloma (Fig. 2), but the uniformity of the miliary mottling, and its presence in bones commonly not involved by either of these conditions, should serve to facilitate the diagnosis. The mottling ob-



Fig. 9. Increase in density of calvarium and return of bone toward normal three and a half months after removal of parathyroid adenoma. This should be compared with the original film (Figure 1) taken three years previously. The miliary granular changes have disappeared but the small cystic lesions are still present and well demarcated.

served in hyperparathyroidism is most closely imitated by the changes seen in metastatic neuroblastoma. In this disease, however, the associated periosteal reaction, and the perpendicular, ray-like formation observed best in the skull, pelvis, and long bones, should render the distinction easy. If doubt still exists, determinations of blood calcium and blood phosphorus will corroborate the diagnosis of hyperparathyroidism.

In the literature, the term osteomalacia is used frequently in association with disturbances of the parathyroid glands. In the general sense of the word, osteomalacia is present, but roentgenographically the osseous changes in hyperparathyroidism bear little resemblance to those observed in the osteomalacia of pregnancy, hunger osteomalacia, and so-called late rickets. The pseudofractures and "unbauzonen" described

by Looser in osteomalacia have not been observed in hyperparathyroidism and will further serve to distinguish the two conditions.

Because of the disturbed calcium metabo-

in stature, due to kyphosis, coxa vara, and softening of the pelvis, persist.

SUMMARY

The roentgenographic changes observed in the osseous system in two cases of hyper-



Fig. 10 (Left). Cystic lesion in right femur three and a half months after removal of parathyroid tumor. This should be compared with Figure 6, of the same case, and the increase in density of bone and return of normal trabeculae noted. The cortex is approaching normal thickness above the cystic lesion.

Fig. 11 (Right). Appearance of tibia two and a half months after removal of parathyroid adenoma. There is increased density of bone, and the area of subperiosteal absorption seen in Figure 7, of the same case, has disappeared. The cortex of each femur has returned to almost normal thickness and the cancellous structure of the bone is now well seen.

lism, renal calculi are not infrequently found, and were observed in Case 2.

Following the removal of a parathyroid tumor there appears to be a definite arrest in the process of decalcification, and the density of the bone, roentgenographically, is distinctly increased (Fig. 9). The bone trabeculae, heretofore indistinct, become more dense and well delineated, and the margins of cystic portions are more sharply defined because of the increased calcium content (Fig. 10). The regions of subperiosteal absorption, observed in Case 2, decreased distinctly two months after removal of a parathyroid tumor, and were replaced by normal bone structure (Fig. 11). The cortex also gradually returned to normal thickness. Changes

parathyroidism associated with tumor of the parathyroid glands are presented. The osseous changes in roentgenograms consist of generalized osteoporosis, cystic lesions, and deformities. The generalized osteoporosis is characterized by a miliary or granular appearance. This change is best observed in the skull and appears to be peculiar to hyperparathyroidism. In addition, the bone trabeculae and cortical bone are thinned, and areas of subperiosteal absorption are seen in the long bones and phalanges. Single or multiple cystic lesions are found in the jaw, pelvic bones, and long bones. These lesions are often confounded with those of osteitis fibrosa and with giant-cell tumor. The deformities due to softening of the bones con-

sist of kyphosis, narrowing of the pelvis, coxa vara, bowing of the legs, and infractions. It is not unlikely that pathologic fractures may even occur. In addition, renal calculi are not uncommonly found. In each instance, removal of a parathyroid tumor was followed by definite arrest of decalcification and progress toward restoration of normal bone structure, as observed roentgenographically.

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CHRONIC APPENDICITIS

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THE subject of "chronic appendicitis" seems to assume periodic importance in the medical literature. Just what each writer means by the term "chronic appendicitis" is often a puzzle. The meaning appears to vary a great deal according to whether the viewpoint is that of the pathologist or the clinician (1). In a previous article I defined "chronic appendicitis" from the clinician's viewpoint as "an appendix which is producing symptoms of distress to a greater or lesser degree over a considerable period of time. These symptoms may be local or remote from the source of irritation" (2). This does not limit us to the inflammatory type, but the appendix must be a source of irritation capable of giving local and remote signs and symptoms: the term "appendicopathia" would perhaps be more appropriate than "chronic appendicitis." One not infrequently reads and hears that "the X-ray offers very little toward the solution of problems of the appendix." On closer investigation one also finds out that these statements are generally made by those who are not in the habit of carrying the gastro-intestinal roentgen examination through the twenty-four and forty-eight hour periods or longer, or are not willing to consider anything but roentgen findings. "Chronic appendicitis," so-called, cannot always be diagnosed clinically or by the roentgen ray alone, but should be diagnosed by the careful weighing of all obtainable facts. If the roentgenologist provides himself with all available data in the interpretation of his roentgenological findings, he surely has by far the most valuable information obtainable. The roentgen findings properly interpreted are most essential, and the roentgenologist, with his gradually acquired knowledge of abdominal abnormalities, is the one who should weigh the evidence and make the interpretation. We can-

not afford to omit a careful history, the symptoms, physical examination, and laboratory findings in conjunction with our roentgenological investigation. The roentgenologist should be a clinician and should not be too busy to give enough time to get these data, if they are not available from hospital and other records.

Our typical findings unfortunately are not always present; in fact, it may be stated that no two appendices, although pathologically identical, will present the same picture, yet atypical findings have value when interpreted in the light of clinical findings. It is our experience that the careful consideration of the clinical data often clarifies an apparent "hodge-podge" of roentgen findings. There is no question but that our most humiliating failures to interpret roentgen findings correctly in most cases could easily have been avoided by a careful consideration of clinical data. Unless we consider all clinical data we are also apt to ascribe too much importance to such abnormalities as we may discover but which may have very little in common with the chief complaint of our patient. Also, an appendix may show many of the earmarks of previous trouble, yet the damage may have been repaired and the appendix may no longer be causing symptoms.

Regarding the interpretation of roentgen appendix findings, the condemnation of this procedure is probably due to several reasons: in the first place, the examination is long and painstaking and requires several visits, which must be paid for; secondly, diagnoses have been made where evidence did not warrant the conclusions, and thirdly, an occasional report of our inability to determine the status of the appendix shakes the surgeon's confidence. The most typical findings may occasionally be erroneous, but no other diagnostic procedure is always ac-

curate, and an occasional failure should not condemn the whole. We attempt to prove that an appendix has all the evidences of normality and, also, none of the evidences of abnormality, or, *vice versa*, that it has all the evidences of abnormality and none of the evidences of normality, a double checking process. It has been my experience that a clinically suspected appendix is very much more often proven normal than abnormal. Fully 75 per cent of our population show, off and on, more or less tenderness on palpation of the right lower quadrant.

Every attempt should be made to ascertain the real cause of symptoms. The low percentage of cases showing permanent improvement after appendectomy for so-called "chronic appendicitis" would indicate that there must be something radically wrong with the diagnoses, and for this reason I am attempting a differential procedure, which, although not infallible, should materially reduce the errors. Much concerning appendicitis and related conditions could be written, but we shall attempt brevity.

The diagnosis of "chronic appendicitis" is in great part a diagnosis by elimination. We cannot limit ourselves to a consideration of the right lower quadrant. We may have local symptoms only or we may find our chief symptoms in the upper abdomen, or we may find a combination of both. The symptoms may be occurring at intervals only, they may follow indiscretions in diet, or they may be of a more or less constant nagging character. We will admit that the symptoms are not necessarily characteristic, but quite variable and often only suggestive, and may be quite similar to those found in numerous other conditions, which should be considered and eliminated if possible. We know our hyposthenic individual, especially when nervously tired, can develop a great number of abdominal symptoms. Numerous minor ailments with such patients seem to be responsible for most violent gastro-

intestinal upsets when combined with injudicious eating.

In the differential diagnosis we must rule out such conditions as hernia or relaxed ring, kidney conditions, ureteral kinks or obstructions, nephrolithiasis, muscle strains, perinephritic infections, spinal arthritis and neuralgias, ovarian cysts and other tumors, pedunculated fibroids, malignancies, pelvic inflammatory disease, pregnancy (especially ectopic pregnancy), diverticulitis and diverticulosis, etc., and also numerous other conditions which indirectly produce right-sided symptoms, such as anal fissures, hemorrhoids, rectal stasis, colitis, etc. Tuberculous peritonitis and even tuberculous nodes are often the cause of abdominal symptoms. The presence of nodal calcification often indicates the probable presence of other swollen, tender nodes. Pulmonary conditions, like tuberculosis, even without intestinal involvement, often produce abdominal symptoms. We have all seen the results of too hasty appendectomies when the condition was an acute pneumonia, with pain referred to the right lower quadrant. Cardiac conditions often cause general and localized abdominal distress. Dental, sinus, ear, tonsil, intracranial and other conditions will affect the gastro-intestinal tract. The great majority of these conditions can be quickly ruled out in our differential diagnosis.

Epigastric distress, frequently associated with an irritative appendix, may be our chief complaint. From the symptomatic viewpoint we may occasionally get a history strongly suggesting gastric ulcer or gall-bladder disease, and in such cases every care should be exercised in not only ruling these out but in finding all the obtainable evidence of an irritated appendix. The sensation is generally that of epigastric distress rather than actual pain, burning, gnawing, or the like, or the patient may have a sense of epigastric pressure or a feeling of distention. Food may or may not have an immediate

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not afford to omit a careful history, the symptoms, physical examination, and laboratory findings in conjunction with our roentgenological investigation. The roentgenologist should be a clinician and should not be too busy to give enough time to get these data, if they are not available from hospital and other records.

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we may not be able to note even the presence of fecaliths. Appendiceal kinks may act similarly. What appear to be kinks are often merely due to the angle of viewing. Large masses of pin worms in the appendix may also produce symptoms, local, and remote (reflex?). A slight fever is not incompatible with a non-inflammatory irritated appendix.

The question of appendiceal fixation is often a difficult one to determine. Inasmuch as a large proportion of inflammatory appendices result from obstruction of the lumen, we naturally find the distal end more frequently adherent than more proximal portions. In obese individuals palpation for the determination of appendiceal mobility is not always so satisfactory, but much can be learned by rotation of the patient through different angles and by observing the appendiceal position at different intervals. The position of the cecum varies considerably, according to the load it carries and the position of the patient. The position of the cecum will often necessarily affect the position of even an adherent appendix, but this rarely of itself causes much confusion. A long appendix gives more reliable information than a short one, as a short mesentery often might not allow much mobility of an otherwise normal free appendix. It may be stated here that a fixed appendix, by too deep and violent manipulation may be made to move *en masse* with other abdominal organs to which it may be adherent, and so seem to be mobile. A retrocecal appendix, the developmental production of which we shall not discuss, has been over-emphasized as a necessary reason for surgery. An appendix apparently retrocecal may be adherent to the anterior wall of the cecum and the differentiation may be most difficult. Viewing the organ laterally, its absolute fixation would seem to indicate a retrocecal appendix. That these retrocecal appendices more frequently pro-

duce symptoms than the ordinary variety does, however, seems to be a fact.

The question of fixation from the pathological viewpoint should be briefly considered. There are innumerable appendices which show evidences of a previous inflammatory process but which are not adherent. An inflamed appendix may show very little which is grossly abnormal on its serosal side: there may be a little injection of the blood vessels and the appearance may be a little less glistening. Such an appendix may function perfectly after the inflammatory process has subsided, but, generally speaking, fixation, kinking, ball-valve fecaliths, impacted inspissated feces, pin worms, appendiceal amebiosis, etc., all favor appendiceal stagnation and a continuance of at least a low-grade irritated condition in the appendix. The presence of abdominal adhesions, which are a frequent post-inflammatory appendix finding, is not always easily determined. A cecum may be malplaced or fixed by bands and developmental folds or by reason of redundancy, over-filling, etc. Pulling of the cecum or colonic wall definitely out of position frequently speaks for adhesions, especially when the bowel wall shows characteristic irregularities. The transverse colon may be drawn down and fixed, as may the duodenum and gall bladder. Dilation of small bowel loops might speak for obstruction from adhesions, etc.

The question of pain from adhesions has been given exaggerated importance—most post-appendectomy pains have been attributed to adhesions. We have seen cases without a symptom in which the abdominal organs were badly matted together by adhesions, and again, we have seen a single small band causing intense pain. The matter seems to be in great measure dependent upon the motility of the adhering organs and the area of surface attachment; in other words, a question of the tug on the sensitive peritoneum. The parietal peritoneum is much more sensitive than the vis-

effect on this sensation, but greasy and difficultly digested food often seems to precipitate these symptoms, which may last for days or weeks. Catharsis frequently gives relief for a while. Very often the patient complains of excessive flatus. Loss of appetite is frequent, and with this there may be nausea to a greater or lesser degree. Occasionally there is a dull ache in the lower right back. Flexing the thigh slightly on the abdomen often relieves a sense of "pulling" in the right lower quadrant. Short attacks of diarrhea, alternating with constipation, are frequent with many pathological appendices. Palpation may produce a sensation of discomfort when any part of the abdomen is so examined, and the colon is frequently spastic and tender. The pain in the right lower quadrant in a truly causative appendix will vary according to the local condition. This distress may not only be local but we find frequently even without real inflammation in the appendix that the entire gastro-intestinal tract is in an irritable state. So-called "duodenitis" is a term which has recently been much overused. We have undoubted cases of "duodenitis," but it is being diagnosed where further investigation would reveal an entirely different underlying or primary condition. Some of our proven irritative appendix cases show every evidence of duodenitis which may be attributed to the generally increased "irritability" of the entire gastro-intestinal tract. Slight indiscretions in diet, because of an already deranged gastro-intestinal function, frequently precipitate much abdominal distress, which is difficult to differentiate from true appendiceal "attacks."

So-called "chronic appendices" may show a great variety of pathological changes, many of a gross character, others made out only by the aid of the microscope. The latter should be liberally interpreted, as variations occur normally in different individuals and with advancing age. The grossly

pathological appendices show a wide range of conditions. There may be enlargement, with edema; inflammatory exudates in the appendix substance or within the lumen, and denudation of the mucosa, or we may find merely vascular congestion, with or without some tissue edema. There may be nodular swellings separated by areas of sclerotic scars and denudation; general or partial obliteration of the lumen, or the distal end may be distended and even closed off from the remainder of the appendix and contain cellular debris or even sterile mucus. The appendix wall may be greatly thickened due to the inflammatory process or we may have a bulbous appendix, with marked thinning of the wall from pressure. There may be fecaliths of varying size and consistency.

Fecal concretions may cause local atrophy of the appendix wall, with local and remote symptoms. The evaluation of the degree of pathogenicity of an appendix fecalith is fraught with difficulties. A good proportion of appendices roentgenographically show fecaliths which probably, in the majority of cases, will not cause more than a rare twinge of local pain. These fecaliths may act as ball-valves and be the cause of acute local pains and also give all the symptoms of an acute gastric condition. The local pains which appear suddenly and disappear with equal suddenness we feel are often due to the accumulated gas and fecal matter attempting to get by such a ball-valve. It is impossible to anticipate what such a fecalith will do next. It should be carefully noted. Palpation of these fecaliths will often reproduce the symptoms complained of, which, if severe or of too frequent recurrence, even without other evidence of an irritated appendix, will justify surgery, which is often inevitable, as a truly pathological condition frequently develops. Between attacks of fecalith irritation or obstruction we may not be able to ascertain anything abnormal about the appendiceal condition, and if the appendix does not fill

superimposed symptoms of operative adhesions. The surgeon should not judge his results until a liberal period of time has elapsed.

Appendiceal stagnation as determined by the retention of barium is a subject of considerable dispute. In the first place, barium retention cannot be proven when the cecum retains free barium, as the appendix may empty and refill, giving the impression of stagnation. As previously mentioned, appendiceal stasis cannot be considered as a probable cause for symptoms, although we do frequently find this association, especially when the appendix retains barium for a period of several days after the cecum has cleared. The ability of an appendix to empty would, however, indicate a free lumen in most cases, and would contra-indicate appendiceal surgery. With a closed-off bulbous tip we may find the proximal end filling and emptying with apparent normality, and if this sign were the only one observed, we should miss the true appendiceal condition. The detail of definition of the barium in the appendix has some significance. An appendix containing mucopurulent exudate may receive the barium, but it will show hazy, indistinct outlines.

The significance of an appendix which cannot be visualized should be considered. This condition is present in about 25 per cent of our cases and offers our most difficult situation. An appendix containing barium but lying over or behind a cecum filled with barium may be easily missed and may show up only after the cecum is clear of barium. It is also possible for an appendix to fill and empty between examinations. It often varies in its ability to take up barium. At one examination the appendix may be plainly seen, while, a few days later, it cannot be visualized. It is most important to make a second examination, after catharsis (the twenty-four-hour examination is usually the most successful for this), before we begin speaking of a blocked appendix. A

swollen non-visualized appendix may sometimes be palpable and the pain may radiate to the opposite side or to the para-umbilical region. Local tenderness should be most liberally interpreted in these cases.

The roentgen study of so-called "sub-acute" appendices offers us considerable aid in the interpretation of roentgen findings in the less acute or chronic forms. The chronic forms we have already described; the sub-acute variety includes appendices in which the reaction is not so violent or in which the acute process has subsided considerably. If inflammatory products have access to a patent appendix lumen, the free drainage will tend to relieve symptoms. A few of the more common roentgen findings are worthy of note.

Needless to say, one finds much variation from the normal. Our stomach may show much irregular hypermotility or we may find gastric atony. There may be duodenal stasis and much erratic reverse small bowel peristalsis. Findings more characteristic, but not invariably present, are pylorospasm with a tendency to a six-hour stomach residue (this seems to be more often present when there are symptoms of nausea). The head of the barium meal may not pass the ileocecal valve at six hours and we find that, having passed this valve, the meal tends to hurry beyond, very much as we find in intestinal tuberculosis. The meal hesitates in its advance toward the ileocecal valve and then rushes beyond, apparently avoiding the zone of appendiceal irritation. The colon is frequently very spastic throughout, and shows frequent variations in appearance. These same events occur to a greater or lesser degree in all forms of chronic appendix irritation. One rarely finds any evidence of a proximal colon retention at the forty-eight-hour period, although small amounts of barium may often be seen in the cecum. The irritable contraction of the valve of Busi may be a reason for this slight retention of barium. The extreme

ceral, but any tug on the mesentery gives rise to a sickening sensation and local pain. Palpating an adherent appendix may show tenderness from this peritoneal tug rather than from an actual inflammatory condition of the appendix. An appendix already under tension will be tender when the pressure is so applied that its distal end is put under increased tension, thus still further stretching the peritoneal covering. It is well to remember that a generally spastic colon has, through its more or less liquid and gaseous content, an equalized tension throughout, and this tension is, of course, transmitted to the appendix, which may be tender when pressure is applied as just described, while tenderness may be absent when the stroke of the palpating hand is toward the proximal end of the appendix.

Local pain on palpation must be carefully considered. This symptom may be most misleading, as we not infrequently see a badly inflamed appendix which is not tender to palpation, and caution in our interpretation is most essential. We may find a pain on palpating the cecal tip, the cause of which, is not always easy to determine. The cecal tension may be fairly high, and this, with the increased palpatory pressure, may produce the pain. There may be a colitis involving the appendix. The cecum is often the site of an old fecalith which may produce local irritation. We occasionally see fecaliths here or elsewhere in the colon producing violent local inflammatory reactions. They may appear to become incorporated in the bowel wall by this inflammatory process. Tenderness about the cecum and appendix will often be found to be no greater than we find on palpating the remainder of the spastic colon. A colon, whose spasticity may be produced by an irritated appendix, is often inexplicably tender, which further complicates our differential interpretation of colonic and appendiceal tenderness. The subject of pain both on palpation and without palpation has

been elaborately investigated (3). Carnett and Boles would have us believe that most right lower quadrant pain is of the nature of intercostal neuralgia, is quite superficial, and may extend over a wide area on both sides and even up the chest. Their method of determining the presence of tenderness upon tensing and relaxing the abdominal muscles, as a means of differentiating superficial from deep tenderness, is worthy of mention.

The relationship of superficial skin hypersensitiveness to deeper pathological conditions offers too great a variation of opinion to allow discussion here. I might add that quite a number of patients are so ticklish that they will tense and withdraw the body from the palpating hand under any circumstances, and so either give the impression of local tenderness or make the examination almost worthless.

Colonic spasticity, with its associated tenderness, has so many possible causes—many of remote, others of local, origin—that we shall not dwell on this subject. We feel, however, that colonic spasticity is frequently the result as well as the cause of appendiceal abnormalities, and should be observed but not over-emphasized. The various sphincteric valves of the colon (Busi, Hirsch, Cannon, Balli, and others) seem to be frequently more irritable and spastic than other portions of the colon. It would be well to mention here that in certain cases where there is a spastic constipation and general colonic tenderness, but no evidence of a truly irritative appendiceal condition, appendectomy has given relief from most of the abdominal symptoms for a variable period, generally from six months to two years. My personal explanation would be that the cutting of the appendiceal nerves (surgical trauma) raises our cecal gradient, which favors colonic elimination. When this elevated cecal gradient is gradually restored to a normal level we find our old symptoms returning, and perhaps with the

tive and the stomach empties rapidly for a while, but the emptying is generally in the end delayed slightly by intermittent pylorospasm. The peristalsis is not the regular

emptying. The advance in the colon may be more rapid and the evidence of a delay in the final emptying may be more pronounced. Often when there is a more active



Fig. 2 The 6-hour film. See text.



Fig. 3. The 24-hour film See text.

deep regular active peristalsis we so frequently find with ulcer of the cap. We frequently find a lack of gastric motility throughout. The cap in this case shows the fibrillary spasms which may be easily pressed out on palpation. The findings are similar to those described for duodenitis. Duodenal stasis, "puddling," and reverse peristalsis are frequent. The usual duodenal finding at operation is "nothing," although we may find some of the findings described as "duodenitis." The "duodenitis," in my mind, may be looked upon in most cases more as a result or symptom, with some other condition, as a pathologic appendix, colon, gall bladder, pelvic inflammatory condition, etc., as the real difficulty.

The six-hour film (Fig. 2) shows a frequent finding—slightly delayed stomach

inflammatory process in the appendix we may even find a gastric residue at six hours.

The 24-hour film (Fig. 3) shows several things of interest. First, we have the irregularly filled appendix, with its tip adherent to the ascending colon, and tender to palpation. We find a rather marked general irritability of the colon, as shown by abnormal haustration. We frequently find more proximal colon clearing. It is my contention that this colonic irritability is often more responsible for the epigastric distress (reflex?) than the actual appendiceal condition which initiates this colonic state. Again, the proximal colon, which is so important in the absorption of digested food products, is not capable of giving "good service" when in such a highly irritable state, and intestinal gas and a feeling of distention result. The term "allochiria,"

spasticity of the colon may actually retard bowel evacuations. One practically never sees an atonic cecum and proximal colon with large amounts of barium at this period when the appendix is in an irritated condi-



Fig. 1. "The stomach presents several points of interest." See text.

tion. Very rarely, we find cecal contents so indurated from many years of local stagnation that even cathartics will not expel them. Such fecaliths may absorb barium and give the appearance of proximal colon stasis and inactivity. If the cecum and proximal colon clear within forty-eight hours, we have eliminated one of our most frequent causes of right lower quadrant distress, namely, cecal stasis with its associated symptoms. Cecal stasis must of necessity often be the cause of appendiceal stasis, the precursor of many of our pathological appendices.

We have described the more important clinical and roentgenologic findings in appendiceal disease, in a rather disconnected manner. However, each point considered can be evaluated only in its relationship to all other findings in any given case.

CONCLUSIONS

Roentgen findings of appendiceal disease are most valuable but must be considered only in the light of all other clinical data

The evidence to be considered is local and remote and dependent upon the kind and degree of appendiceal abnormality. There can be no set of rules to govern the diagnosis of a pathologic appendix, and personal judgment must necessarily enter. The roentgenologist, in view of his long experience with numerous roentgen abnormalities, is in a most favored position to interpret these roentgen findings, providing he avails himself of all other obtainable information. A differential consideration of local and remote, direct and indirect, clinical and roentgen findings is presented which should materially reduce our diagnostic failures.

The above description may make it appear that the diagnosis of so-called "chronic appendicitis" is always a very complicated matter, but in most of the cases a diagnosis can be easily established with more than a fair degree of certainty.

ILLUSTRATIVE CASE

About four years ago this patient (Dr. F. K. S.) had an attack of what was termed "intestinal flu" — slight fever, nausea, abdominal cramps, constipation following diarrhea. Since then he has been troubled with periods of faulty digestion. The symptoms were distress in the epigastrium, flatulence, and a general feeling of distention. This condition was apparently worse after heavy, especially greasy, meals. At times there was a little "burning," which came late, after meals. Reduction in food intake brought about almost complete relief.

Findings are those of a definitely irritated appendix, with many of the symptoms probably due to secondary reflex phenomena. The general irritability of the entire gastro-intestinal tract is characteristic.

The stomach presents several points of interest (Fig. 1). We see an irritable stomach: at times the peristalsis is very ac-

ATYPICAL BONE TUMORS¹

WITH PRESENTATION OF TWO CASES

By K. S. DAVIS, M.D., M.S. in Roentgenology, LOS ANGELES, CALIFORNIA

IN the diagnosis of bone tumors there are many borderline and atypical lesions which are not clear-cut either roentgenologically or pathologically. There are instances in which it is almost impossible to decide whether the lesion is benign, malignant, or inflammatory on the basis of the roentgenographic and clinical findings alone.

The two cases included in the present report illustrate very well the difficulties encountered in making a correct diagnosis in the unusual and atypical bone tumor.

Case 1. The patient, a male, 35 years of age, was admitted to St. Vincent's Hospital September 30, 1929, because of a fracture of the left humerus. Three years previously the left shoulder and humerus became painful following vaccine therapy for a chronic neisserian infection. Since that time the patient had had repeated attacks of pain of increasing severity in the same area. In May, 1929, the symptoms became very much aggravated following a fall on the left shoulder, with almost continuous pain since then. September 19, 1929, the humerus suddenly fractured while he was carrying a case of films.

The roentgenogram made at the time of his admission to the hospital showed a pathologic fracture in the middle third of the shaft of the left humerus. The entire upper half of the humerus including the head and neck showed a mottled, diffuse rarefaction, and the diameter of the bone was increased about 50 per cent over normal, although this increase in size did not appear to be due to a true expansion of the cortex. The cortex, while thinned out, was still intact except at the site of the fracture. There

was no soft-tissue swelling or any demonstrable periosteal proliferation noted (Fig. 1).

Roentgenograms were made of practically all the other bones, all of which appeared to be normal in structure.

Subsequent roentgenograms of the left humerus showed, in addition to the changes noted above, a periosteal proliferation and an extension of the process into the soft tissues surrounding the humerus. The soft-tissue tumor was first noted near the site of the fracture; later the entire upper half of the arm became involved (Figs. 2 and 3).

X-ray treatments were commenced December 4, 1929, and continued until December 26, 1929. During the course of the treatments the growth remained stationary in size but there was not the regression of the tumor which we had expected.

In January, 1930, the patient, learning of the Coffey-Humber serum, left our care and went to San Francisco. There he was given a series of serum treatments over a period of seven weeks. During this time there was a rapid growth of the tumor, which soon became very large. The patient failed rapidly and died two weeks after his return home.

The autopsy, done on March 10, 1930, showed a tumor of the left arm involving the bone, soft tissues, and skin. The greater portion of the upper half of the shaft of the humerus was missing, there being only a few small, eggshell-like fragments of the cortex embedded in the tumor. The head of the humerus was filled with gelatinous necrotic material but the shoulder joint and scapula were not involved. The tumor was very soft, gray in color, and intact in portions; other parts were yellow and necrotic

¹Read before the Radiological Society of North America, at the Annual Meeting at Los Angeles, Dec. 1-5, 1930.

meaning pain reflexly referred to the side opposite the trouble, often does not apply. I am inclined to believe that colonic spasm, often more marked at the points of the dif-

there is appendiceal irritation, but is by no means pathognomonic of an irritated appendix.

The 48-hour film (Fig. 4) shows the same degree of colonic spasm with otherwise normal emptying. Stasis at the cecal tip is occasionally found. The appendix shows a certain degree of stasis in most cases in which it is patent, although an irritated appendix tip may cause rapid emptying of the proximal end. The appendiceal shadow of barium narrows irregularly due to absorption of fluid and may eventually form the center of a somewhat inspissated core. New material flows into the appendix circumferentially about this appendiceal core by a mere process of appendiceal dilatation, just as we find in the colon. This circumferential advance of the liquid contents from the small bowel in the colon brings the liquid contents in contact with a maximum surface of absorbing colonic epithelium, thus hastening the withdrawal of fluid, with its nutritive products.



Fig. 4. The 48-hour film. See text.

ferent colonic valves (Hirsch, Busi, and others), can easily account for the pain symptoms on the opposite side of the abdomen. This colonic irritability, manifested in several ways, is generally found when

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formed acini, which show that the tumor must be some form of metastatic carcinoma.

"I think this tumor must be a metastatic carcinoma from some source. The radiograph is characteristic of a very destructive metastatic carcinoma. The tumor cells are too large and spindle for endothelial myeloma. Alveoli are not present in endothelioma."

Sections were also sent to Dr. A. C. Broders at the Mayo Clinic, who diagnosed the tumor as a rhabdomyosarcoma.

COMMENT

In this case we have a bone tumor, medullary in origin, involving the upper half of the shaft of the humerus, causing a marked increase in the diameter of the bone. In the first roentgenogram the cortex showed a mottled, diffuse rarefaction but was intact except at the site of the pathologic fracture. Later there was noted a roughening of the periosteum, which periosteal proliferation did not have the radiating spicules of osseous tissue perpendicular to the shaft as seen in a typical periosteal osteogenic sarcoma. The spread of the tumor into the surrounding soft tissues apparently occurred first at the site of the fracture. Intensive X-ray treatments caused a cessation of the tumor growth but no regressive changes were observed during the treatments. During the period in which the Coffey-Humber serum was given the tumor increased rapidly in size, with progressive constitutional symptoms until death ensued.

Case 2 R F, a well developed male, 67 years of age, first presented himself for examination in September, 1928. He complained chiefly of pain and a tumor on the anterior part of the left leg about ten inches below the knee. In March, 1927, the patient had fallen, tripping over a tight wire, and injured his left leg over the tibia. The swelling appeared immediately after the in-



Fig. 3. Case 1. Roentgenogram taken after the tumor had spread to the soft tissues. This was first noticed at the site of the fracture. Later the entire upper half of the arm became involved.

jury and had persisted since that time. The pain, which consisted of a dull ache in the affected leg, had been intermittent in character, disappearing when the leg was at rest and reappearing when the patient resumed his normal activities—motoring and golf. His general health had always been excellent. The Wassermann test had been repeatedly negative, even after provocative salvarsan had been given.

ROENTGENOGRAPHIC FINDINGS

The first roentgenogram, taken October 4, 1927, showed a fairly circumscribed area of diminished bone density about 3×4 centimeters in diameter in the cortex of the left tibia. The lesion was apparently cortical in origin, expanding and thickening the cortex and partially obliterating the medullary cavity but with no evidence of direct involvement of the medulla. Above the main lesion



Fig. 1. Case 1. Roentgenogram taken at the time of admission to St Vincent's Hospital. The extent of the tumor, the increased diameter of the bone, the thinned but intact cortex, and the pathologic fracture are the outstanding findings in this film.



Fig 2. Case 1. A subsequent roentgenogram showing the periosteal proliferation. At the time this film was made there was a marginal union between the fractured fragments.

and some were gelatinous. There was no involvement of the soft tissues of the axillary space.

The abdominal cavity contained about two liters of blood, fluid and in clots. The liver was greatly enlarged, containing many tumor masses of varying size. Many of the masses were necrotic; in one of the tumors there was a definite hemorrhagic necrotic mass which had broken through the capsule and accounted for the free blood found in the peritoneal cavity. Metastases were also present in the head of the pancreas, retroperitoneal lymph nodes, and lungs.

Sections of the humerus, the soft-tissue tumor of the arm, and the metastases showed a highly cellular, large spindle-cell tumor. Many cells were elongated and had compact dark staining nuclei. Mitotic figures were abundant. In the head of the humerus there was an extensive mucinous

degeneration and necrosis. Necrosis was also present in irregular areas throughout the entire tumor mass.

Dr. G. D. Maner, who performed the autopsy, made a microscopic diagnosis of periosteal sarcoma with generalized metastases.

Sections of the tumor were sent to Dr. James Ewing, whose report is as follows: "You have sent me material from a very remarkable bone tumor. Most of the sections show a structure which might well be an osteogenic sarcoma. The cells are very large and spindle, although some are large and polyhedral. There is a good deal of degenerating soft cartilage which does not seem to belong to the tumor process. There is a section of peculiar reticulated tissue which I cannot explain. It looks somewhat like thyroid tissue. In portions of the tumor there are very numerous, perfectly well

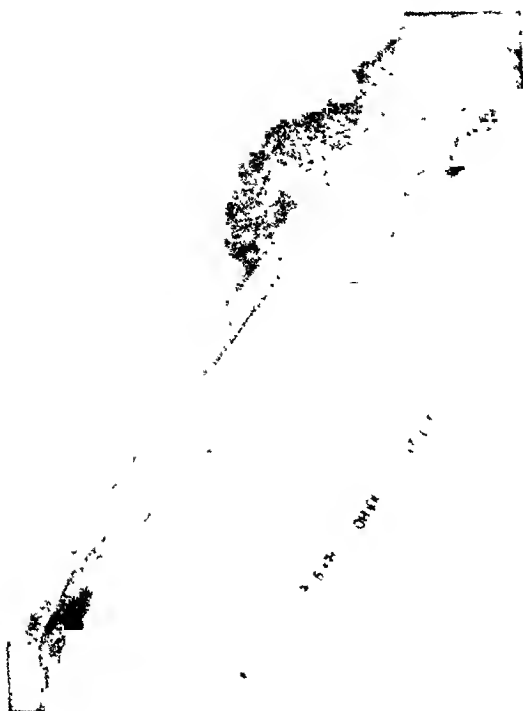


Fig. 6. Case 2. Lateral roentgenogram taken in 1928. In this film there can be seen the main tumor with three adjacent intracortical areas of rarefaction lying above the main tumor just beneath the anterior periosteal surface of the cortex.



Fig. 7. Case 2. Lateral roentgenogram taken two years later. (Compare with Figure 6) Following the X-ray and radium treatments the cortical bone surrounding the bone tumor showed a distinct increase in density. There is a coalescence of the three small lesions seen in early roentgenograms

Roentgenograms of practically all the other bones failed to show demonstrable evidence of involvement.

Because of a sharply divided difference of opinion between the local radiologists in Los Angeles, roentgenograms were sent to Dr. G. H. Holmes, of Boston, Dr. B. R. Kirklin and Dr. M. S. Henderson, of the Mayo Clinic, and Dr. Ralph E. Herendeen and Dr. James Ewing, of New York City. It was the opinion of all of these men that the process should be classified as an inflammatory lesion rather than a neoplasm, and an exploratory operation was advised. This was done on May 15, 1930, by Dr. John Wilson, whose surgical report is as follows: "An extremely vascular tumor, with softening of the cortical bone. A wedge-shaped piece of tissue $4 \times 2 \times 2$ cm. was removed for

biopsy. The cortical portion of the bone tumor is very hard and somewhat eburnated; beneath this a soft grayish tumor can be seen between the bony spicules."

Frozen sections of the softer parts of the tumor showed a cellular fibrous tissue stroma surrounding irregular spaces, lined by atypical high columnar epithelium often two or more rows deep. Microscopic diagnosis: metastatic carcinoma of the tibia.

The amputated leg showed a bulbous enlargement of the tibia due to a bone tumor measuring $12 \times 6 \times 5$ centimeters. The marrow cavity was obliterated by cancellous bone, the spaces of which were filled with a grayish tumor. There was a small tumor, similar in appearance, lying above the main tumor. The soft parts were not involved.

Microscopic sections were sent to Dr. Wil-



Fig. 4. Case 2. Antero-posterior roentgenogram taken soon after patient's injury. Note the cortical area of diminished bone density, with an expansion of the periosteal surface of the cortex but no thinning.



Fig. 5. Case 2. Antero-posterior roentgenogram taken a year later. The tumor has increased in size but is still sharply delimited. The cortex is expanded but not thinned. The bone surrounding the tumor is denser than in the previous film (Compare with Figure 4.)

there were three intracortical areas of rarefaction lying just beneath the periosteal surface of the cortex (Figs. 4 and 6).

From October, 1927, until February, 1930, numerous roentgenograms were made, these showing a slow progressive development of the lesion described above.

The development consisted of: (1) A gradual increase in the size of the central area of rarefaction; (2) an expansion of the cortex, which became thickened instead of thinned; (3) a coalescence of the three upper lesions which, however, remained definitely divided, appearing as three lesions adjacent to each other but not merged; (4) appearance of periosteal new bone with a rather characteristic parallel cortical striation of the newly formed bone (Figs. 5 and 7).

At this point a tentative diagnosis of Ewing's tumor was made and the patient referred to Dr. Albert Soiland for X-ray therapy. A series of ten X-ray treatments were given, beginning October 15, 1928

On May 15, 1929, a series of radium applications was given over the anterior part of the left leg. Twelve applications were given, using radium filtered by 1 mm. of brass and applied at a distance of 3 centimeters—a total of 4,260 milligram-hours.

In spite of the radiation and radium therapy the lesion continued to progress slowly in size, although, in the opinion of the essayist, it showed a distinct increase in the density of the surrounding cortex following the X-ray treatments. The patient stated that the bone felt "stronger" although the pain was still felt when he played golf.

THE RADIOLOGICAL STUDY OF THE STOMACH AND DUODENUM, WITH SPECIAL REFERENCE TO THE VALUE OF THE LATERAL VIEW¹

By SAMUEL BROWN, M.D., CINCINNATI, OHIO

THE value of the lateral view of the stomach and duodenum is, in my opinion, not fully appreciated by radiologists at large. This is evidenced by the infrequent reference to its use in the X-ray literature and also by the total absence of illustrations of the lateral view of the stomach and duodenum in standard books dealing with the radiological diagnosis of gastro-intestinal lesions. The chief reason for the lack of interest in the use of the lateral view is the assumption that any lesion affecting the stomach or duodenum which can be demonstrated radiologically can be shown in the usual anterior view. This is indeed true for the majority of lesions, but not for all, in my experience. Time and again I have found that the lateral view, either left or right, has enabled me to demonstrate the presence of a lesion absolutely impossible of such demonstration in the usual anterior view.

The study of the normal stomach and duodenum in the lateral positions has been the subject of several of my previous publications (1, 2, 3). In the present communication I will confine myself to a brief discussion of the anatomical and physiological characteristics of the stomach and duodenum, together with several brief case reports accompanied by illustrations in the anterior and lateral views.

1. The position, shape, and size of the stomach and duodenum depend a great deal upon the habitus and age of the individual. Before any conclusions are drawn these data concerning the individual under ex-

amination should be taken into consideration.

2. The stomach and duodenum are, relatively speaking, freely movable organs, and, as such, their position and shape will to a large degree depend upon the position of the body as a whole.

3. The stomach and duodenum are elastic organs and therefore capable of expansion. Thus, their size, shape, and position will depend upon the quantity of food ingested.

4. The stomach and duodenum are muscular organs and therefore possess capacity for contraction and relaxation. Thus their position, shape, and size will depend upon the muscular tone, upon the degree of peristalsis, and upon the rate of emptying.

5. A knowledge of the shape of the normal stomach and duodenum in the several standard positions, namely, dorsal, ventral, left and right lateral, is important in order to be able to recognize any deviation from the normal contour.

6. The position and shape of the stomach and duodenum are subject to alteration as a result of changes in the size and position of the neighboring organs, such as the liver, spleen, kidneys, pancreas, and pelvic organs. Thus a knowledge of the normal relations which exist between the stomach and duodenum and their neighboring organs both in the antero-posterior and lateral positions is essential in order to recognize any abnormal change in the neighboring structures.

7. The size or volume of the stomach depends upon its length, breadth, and depth. Only by the use of the antero-posterior and lateral views can one obtain a fair idea of

¹Read before the Radiological Society of North America, at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1-5, 1930.



Fig. 8 Case 2 Roentgenogram made of the tumor after amputation of the leg. The extent of involvement is best illustrated here.

liam Ophuls, of Stanford University, Dr. A. C. Broders, at the Mayo Clinic, and Dr. Ewing, of New York City, all of whom agreed as to the diagnosis.

COMMENT

In this case we have a localized metastasis to the left tibia in a patient whose general health has always been excellent. The roentgenographic appearance was certainly not indicative of such an involvement. A careful history and thorough physical examination failed to reveal any possible primary source for the metastatic growth. Roentgenograms of practically all the other bones in the body were negative for demonstrable involvement. The lesion was extremely slow in its growth and showed as much bone proliferation as destruction. It

was sharply delimited, never showing any tendency to invade the surrounding bone or soft tissue. At the present time (December, 1930) the patient's general health is still excellent and he shows no evidence of a malignant lesion in any part of the body.

DISCUSSION

DR. JOHN C. WILSON (Los Angeles, Calif.): The first patient (Case 1), when he came under our observation, appeared to be suffering from a benign lesion resembling osteitis fibrosa cystica. A possibility of a bone lesion associated with leukemia or splenic anemia was also considered. The presence of a malignant tumor was not suspected until a rapidly growing soft-tissue tumor appeared at the site of the pathologic fracture. Because of the fact that this patient had a claim under dispute before the Industrial Accident Commission it was not possible to undertake any surgical treatment until the condition was obviously inoperable. It is interesting to note the extreme rapidity with which this tumor grew and metastasized after treatment with the Coffey-Humber extract.

Regarding the second case, a word of explanation should be offered to account for the rather unusual procedure of amputation for bone carcinoma, presumably metastatic. The slow growth and circumscribed nature of the lesion, its steady progress in spite of radiotherapy, the patient's excellent general condition, and the absence of a demonstrable primary lesion made us feel that amputation might offer a prolongation of life in addition to relief from the troublesome local symptoms. The exploratory operation undertaken on the advice of consultants rendered the amputation imperative.

Cases such as these, in which conflicting opinions by the radiologists and pathologists are added to inconclusive clinical findings, place a grave burden of responsibility on the surgeon.

W. A. Brown
1932

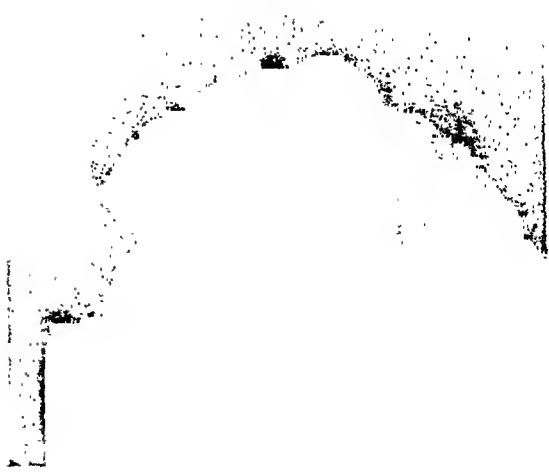


Fig. 2-A (anterior view). The lesser and greater curvatures present no deformities in contour. (Upper left.)

Fig. 2-B (left lateral view). Considerable deformity involving the upper half of the posterior wall of the stomach. (Upper right.)

Fig. 3-A (anterior view). No deformities are present on the lesser or greater curvature of the stomach. (Lower left.)

Fig. 3-B (right lateral view). Marked deformity involving the middle third of the stomach. (Lower right.)

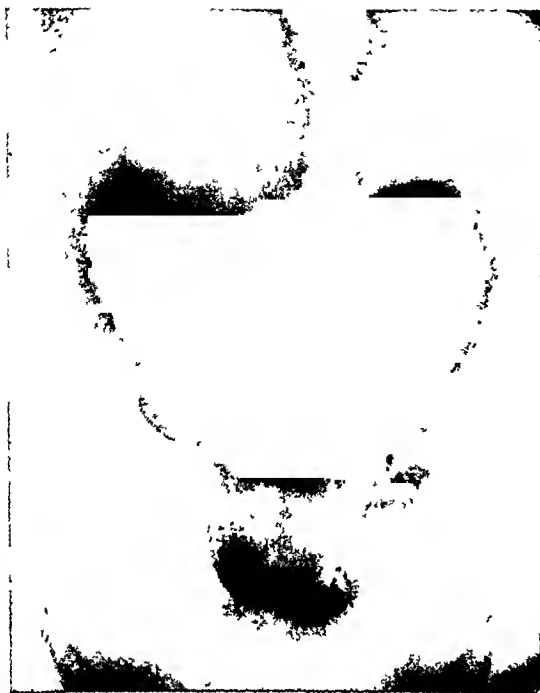


Fig. 1-A (anterior view). No deformities are present on the lesser or greater curvature.



Fig. 1-B (left lateral view). Marked deformity involving the cardiac end of the stomach

the actual size of the stomach. It is generally found that the so-called small "steer-horn stomach" has greater depth than the "fish-hook stomach" when they are studied in the lateral position. In other words, the steer-horn or transverse type of stomach makes up in depth what the fish-hook type of stomach makes up in length.

8. Foreshortening of the stomach in the anterior view may occur in the steer-horn or transverse type of stomach. This is due to the fact that the stomach does not lie parallel with the abdominal wall, but at an angle, with the direction of its axis from before backwards. Foreshortening of the stomach is more apt to occur in pathological stomachs than in normal ones, because of scar tissue or adhesions. In the lateral view it is often possible to overcome this difficulty and expose the entire contour to view.

9. In the transverse type of stomach the

duodenal bulb is frequently located behind the pylorus and thus obscured from view, and its study is naturally made difficult. In the right lateral view the duodenum can be exposed in its entire course and any abnormal changes can be noted.

10. Deformities in the contour of the stomach and duodenum can be recognized so long as they occur at the periphery of the X-ray shadow. It is evident that, if a deformity involves the anterior or posterior walls of the stomach or duodenum, the patient should be placed in such a position that the anterior and posterior walls will be at the periphery of the X-ray shadow. This position is either the left or right lateral

11. The duodenojejunal flexure is located beneath the body of the pancreas: in the vertical stomach it is often seen above the lesser curvature. In the transverse stomach it is usually found to be obscured by the

will bear a normal relation to the abdominal wall and spine.

13. The position and shape of the stomach are often influenced by palpable or non-palpable tumors within the abdominal cavity. The following process of differentiation has been found of great service.

(a) A tumor originating from the stomach will seldom change the position of the stomach. The deformity in the contour of the stomach, whether visible or non-visible in the anterior view, can always be demonstrated in either the left or right lateral view.

(b) A splenic tumor will displace the stomach and duodenum to the right and forward and the splenic flexure downward.

(c) A liver tumor will displace the stomach and duodenum to the left and backward.

(d) Right kidney tumor will displace the stomach and duodenum to the left and forward.

(e) Left kidney tumor will displace the stomach and duodenum to the right and forward.

(f) Pancreatic tumor will displace the stomach forward and if any lateral displacements occur the stomach and duodenum will be displaced in opposite directions. The duodenojejunal flexure is often found to be displaced downward by pancreatic tumors.

(g) Retroperitoneal tumors originating from the retroperitoneal glands behind the stomach will displace the latter forward. The position of the duodenojejunal flexure is not affected.

CASE REPORTS

Case 1 (Figs. 1-*A* and 1-*B*). Male, age 54, complained of a moderate degree of gastric distress, with marked anemia. Clinically there was a strong suspicion of gastric cancer. X-ray examination of the stomach

elsewhere had failed to confirm this suspicion. In my examination I found the stomach free from any deformities in the anterior view (Fig. 1-*A*). In the left lateral view (Fig. 1-*B*) an extensive deformity was found to involve the cardiac end of the stomach. The diagnosis of carcinoma was confirmed by operation.

Case 2 (Figs. 2-*A* and 2-*B*). Male, age 66, presented symptoms suggestive of cancer of the stomach. In the anterior view (Fig. 2-*A*) no filling defects were noticed in the contour of the lesser and greater curvatures. In the left lateral view (Fig. 2-*B*) an extensive deformity was noticed along the posterior wall of the stomach in its upper third. A diagnosis of cancer of the stomach was confirmed by operation at the Mayo Clinic.

Case 3 (Figs. 3-*A* and 3-*B*). Male, age 59, had complained of gastric disturbances for over a year. During this time he had been submitted to several X-ray examinations of the stomach by various radiologists, but without finding any abnormal changes. His condition gradually became worse from loss of blood by rectum. He was examined by me after he had been admitted to the hospital and after several blood transfusions had been done. I found no deformities involving the lesser or greater curvatures in the anterior view (Fig. 3-*A*). In the right lateral view (Fig. 3-*B*) a large deformity was noticed, involving the middle portion of the stomach. A diagnosis of cancer of the stomach was confirmed by operation and a microscopic section.

The above three cases illustrate the possibility of failing to make a correct diagnosis if one is to depend upon the study of the stomach in the antero-posterior position alone. The third case is the most remarkable because of the existence of an extensive deformity which showed not the slightest change in contour in the anterior view.

The value of the lateral view is also



Fig 4-A (anterior view). Circumscribed defect in the middle of the stomach.



Fig 4-B (right lateral view). The deformity involves the anterior wall of the stomach.

stomach, or it may be seen close to the greater curvature. A considerable separation between the greater curvature and the duodenojejunal flexure should lead one to suspect a possible pancreatic tumor.

12. Artificial deformities of the stomach and duodenum as a result of outside pressure exerted upon their walls are usually considered a hindrance in the study of these structures. However, these deformities possess certain advantages in directing one's attention to something abnormal within the abdominal cavity. By a process of differentiation one can readily determine the true cause of the deformity.

(a) A deformity which is due to a tumor within the stomach will accentuate the abnormal shadow when the patient lies flat on the abdomen, and very often displaces all the barium between the anterior and posterior walls of the stomach. The exact extent

of the tumor and its exact origin can be determined only by the use of the lateral view.

(b) A deformity of the stomach due to pressure by a mass between the stomach and the anterior wall of the abdomen will disappear when the patient is studied in the lateral position; however, the stomach will be found displaced backwards and the anterior wall of the stomach will present a regular crescent-shape compression.

(c) A deformity of the stomach due to pressure by a mass behind the stomach will disappear when the patient is placed in the lateral position, but the stomach will be found to be displaced forward and the posterior wall to be compressed.

(d) A deformity of the stomach due to extra-abdominal pressure will disappear when the patient is placed in the lateral position. In this case the walls of the stomach

shown when it is desired to determine the exact origin of a tumor which is recognizable in the usual anterior view. The following two cases will illustrate this point.

Case 4 (Figs. 4-A and 4-B). Female, age

is seen to be involved. This was confirmed by operation.

Case 6 (Figs. 6-A and 6-B). Female, age 48, had presented gastric symptoms for several years. In the anterior view (Fig. 6-A)



Fig 7-A (anterior view). No filling defects are shown on the lesser or greater curvature of the stomach or duodenum.

43, had complained of gastric distress for more than two years. At the time of the onset of her illness she was subjected to an X-ray examination of the stomach, with the diagnosis of a duodenal ulcer. She was treated for that lesion, but without any improvement. A subsequent X-ray examination of the stomach revealed a large circumscribed filling defect in the middle of the stomach (Fig. 4-A). In the lateral view (Fig. 4-B) the anterior wall of the stomach appears to be the origin of the newgrowth. A diagnosis of benign tumor was confirmed by operation and microscopical section.

Case 5 (Figs. 5-A and 5-B). Male, age 70, complained of gastric disturbances suggestive of cancer of the stomach. In the anterior view (Fig. 5-A) a large filling defect is shown to involve the whole of the pylorus. In the right lateral view (Fig. 5-B) only the anterior wall of the stomach



Fig 7-B (right lateral view). The posterior wall of pylorus presents a filling defect, and the duodenal bulb is deformed.

an indentation of the greater curvature is seen, but no niche on the lesser curvature corresponding to the region of the hour-glass constriction. In the right lateral view (Fig. 6-B) a characteristic niche deformity is seen on the posterior wall.

Case 7 (Figs. 7-A and 7-B). Male, age 47, had complained of gastric disturbances for several years. In the anterior view (Fig. 7-A) no deformities were noticed in the contour of the lesser or greater curvatures. In the right lateral view (Fig. 7-B) a distinct filling defect is seen on the posterior wall of the pylorus. The duodenal bulb shows an irregular outline of its anterior wall. A diagnosis of pyloric ulcer

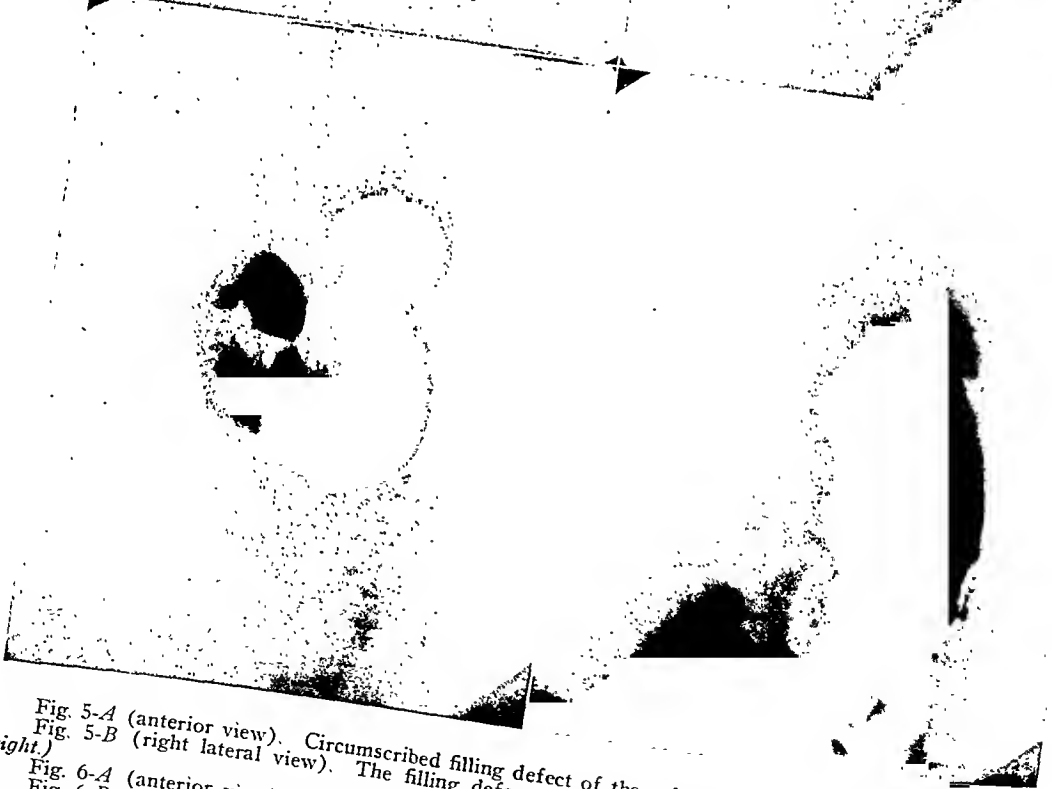
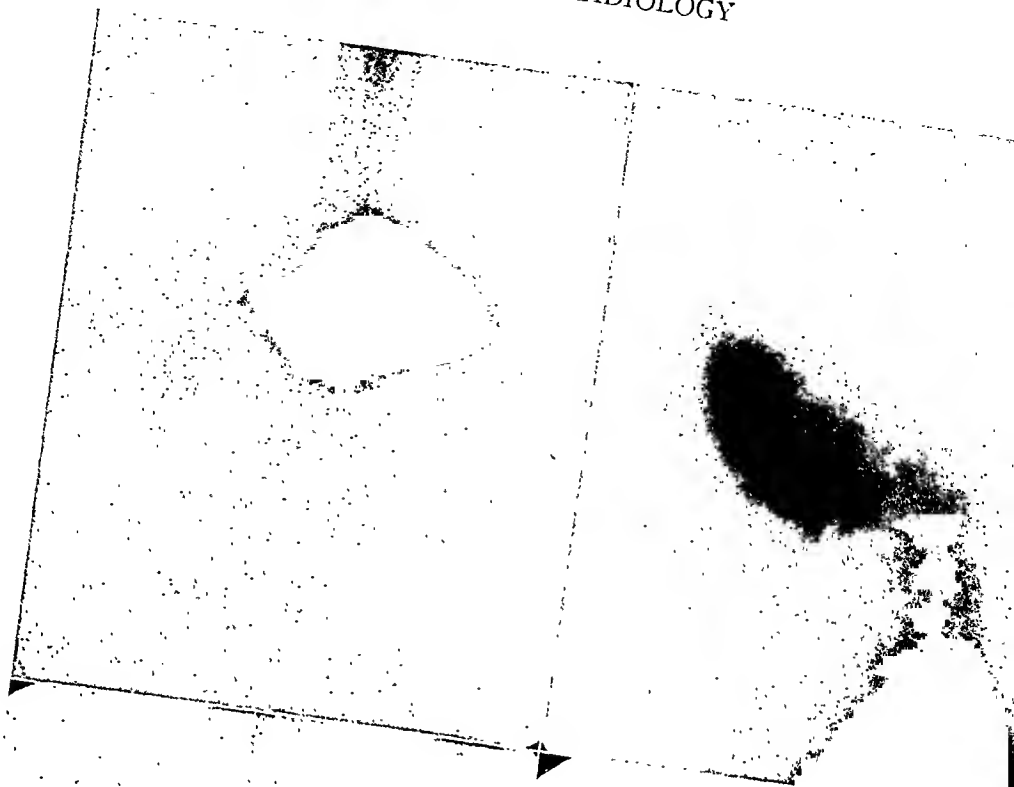


Fig. 5-A (anterior view). Circumscribed filling defect of the pylorus. (Upper left.)

Fig. 5-B (right lateral view). The filling defect involves the anterior wall of the pylorus. (Upper right.)

Fig. 6-A (anterior view). Hour-glass indentation of the upper end of stomach. (Lower left.)

Fig. 6-B (right lateral view). Niche is shown on the posterior wall opposite the constriction of the greater curvature. (Lower right.)

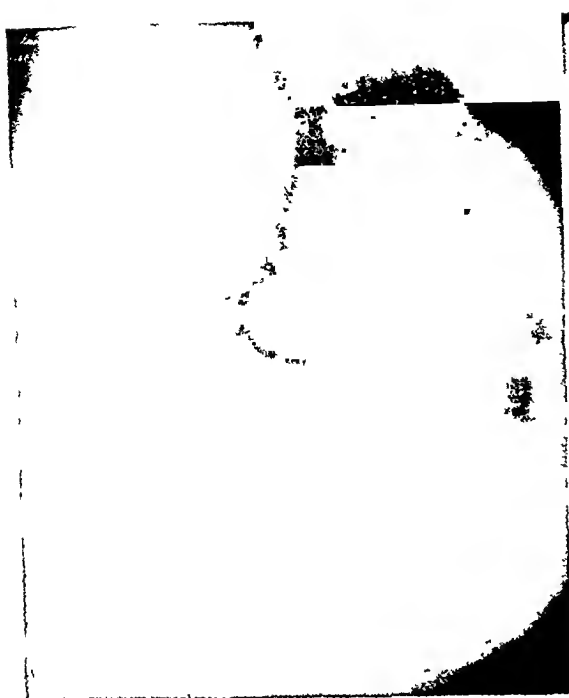


Fig. 9-A (anterior view). No filling defects are seen on the lesser or greater curvature. The duodenal bulb is obscured by the pylorus

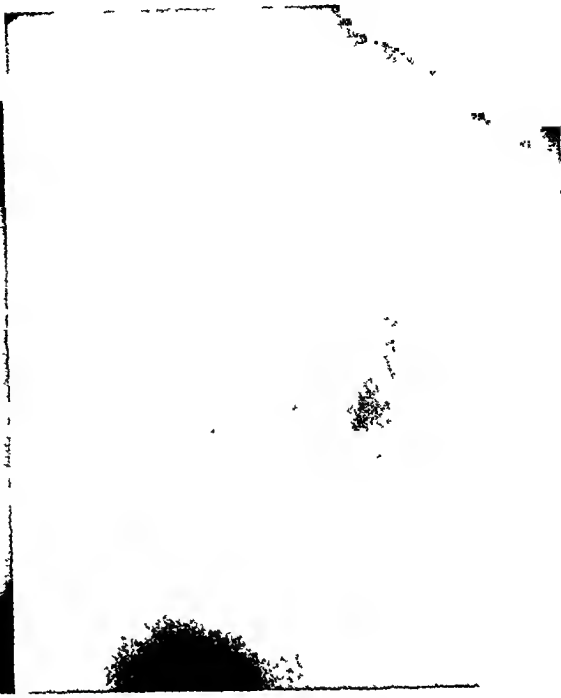


Fig. 9-B (right anterior view). Niche is shown on the upper surface of the duodenum.

Case 10 (Figs. 10-A and 10-B). Female, age 57, was examined elsewhere and obstruction was found in the region of the duodenojejunal junction. This was considered to be due to a newgrowth arising from within the bowel. In my examination I confirmed the same findings (Fig. 10-A); however, it was also noticed that the duodenojejunal flexure was displaced downward and the pyloric end displaced upward. The greater curvature of the pylorus presented an ill-defined contour. In the left lateral view (Fig. 10-B) the stomach was found to be displaced upward and forward. It has been my experience that the position of the stomach seldom changes from a growth originating inside itself or the duodenum, hence, I reasoned, the displacement must be due to a growth originating outside the stomach and duodenum. Since the relation between the stomach and duodenojejunal flexure has been found altered, and

such an alteration can be produced only by the body of the pancreas, because it lies just above the bowel, a diagnosis of cancer of the pancreas was made. This was confirmed by operation and, several days later, by a postmortem examination.

Case 11 (Figs. 11-A and 11-B). Male, age 45, had complained of pain in the epigastrium and back for several months before admission to the hospital. An X-ray examination of the gastro-intestinal tract made elsewhere failed to reveal anything abnormal. In my examination I found a distinct deformity along the greater curvature of the stomach, but not involving the latter (Fig. 11-A). The duodenojejunal flexure was found to be displaced downward. In the left lateral view (Fig. 11-B) the stomach was found to be displaced upward and forward. The posterior wall of the stomach was found to be ill defined. By the same process of reasoning as applied in

with duodenal adhesions was confirmed by operation.

Case 8 (Figs. 8-A and 8-B). Male, age 30, presented a typical history of gastric ulcer. In the anterior view (Fig. 8-A) no

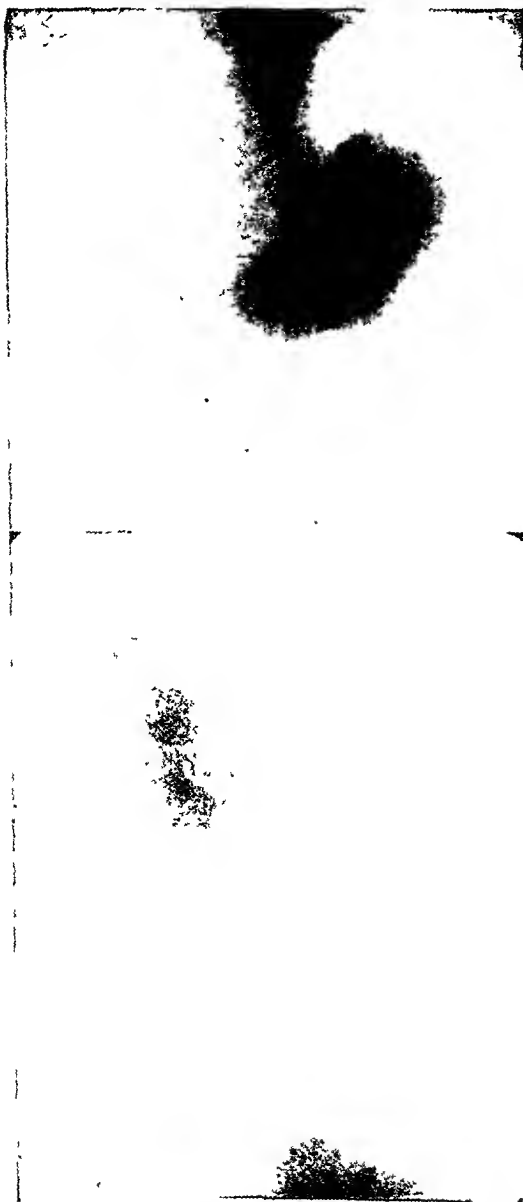


Fig. 8-A (anterior view) No filling defects are seen on the lesser or greater curvature. The duodenal bulb is obscured by the pylorus. (Top)

Fig. 8-B (right lateral view). The posterior wall of the stomach presents a niche. The duodenum is shown in its entire course. The upper surface presents a niche. (Bottom)

filling defects were noticed in the contour of the stomach. The duodenal bulb could not be seen because it was lying behind the pylorus and was thus obscured from view. In the right lateral view (Fig. 8-B) a distinct niche is seen on the posterior wall of the stomach. Its presence was constant and it failed to disappear during a peristaltic wave. The duodenal bulb presented a distinct shadow of a niche on its upper surface. The diagnosis of a gastric and duodenal ulcer was made. The failure to demonstrate these deformities in a subsequent examination after an interval of several months, following a rigid medical and dietetic régime, with the disappearance of the gastric symptoms, would lead one to conclude that the diagnosis was correct.

Case 9 (Figs. 9-A and 9-B). Female, age 63, complained of gastric symptoms suggestive of cancer of the stomach. The anterior view (Fig. 9-A) failed to show any deformities in the contour of the stomach. The duodenal bulb was found entirely obscured by the pylorus. In the right lateral view (Fig. 9-B) a small niche was seen to arise from the upper surface of the bulb. A diagnosis of duodenal ulcer was confirmed by operation.

The above four cases illustrate the possibility of overlooking the existence of an ulcer of the stomach or duodenum if it does not happen to be located on the lesser or greater curvature. In the case of the duodenum another factor enters in, rendering the diagnosis of ulcer difficult: the bulb is often located behind the pylorus and thus its study is made impossible. In the right lateral view the entire course of the duodenum can be demonstrated and any abnormal changes can readily be noted.

Thus far, lesions of the stomach and duodenum of intrinsic origin have been discussed. I shall now present several cases of extrinsic origin affecting the stomach and duodenum.

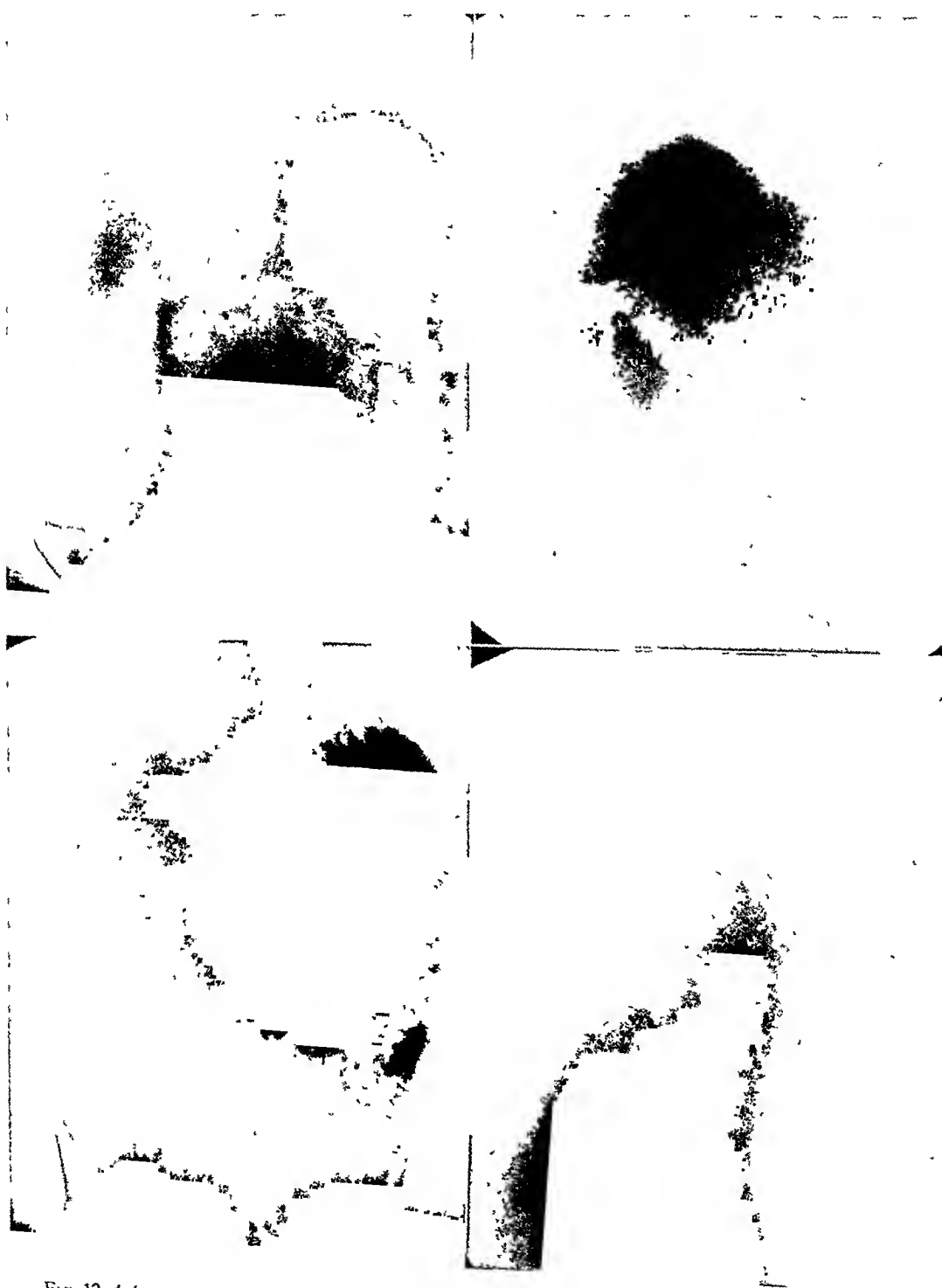


Fig 12-A (anterior view). The pyloric end is obliterated. The stomach is displaced to the left and the duodenum to the right. (*Upper left.*)
 Fig 12-B (right lateral view). The stomach and duodenum are displaced forward due to a retro-peritoneal tumor. (*Upper right.*)
 Fig 13-A (anterior view). The pylorus is obliterated. The duodenal bulb is displaced to the left. (*Lower left.*)
 Fig 13-B (right lateral view). Stomach is displaced backward. The anterior wall is compressed due to a large liver. (*Lower right.*)

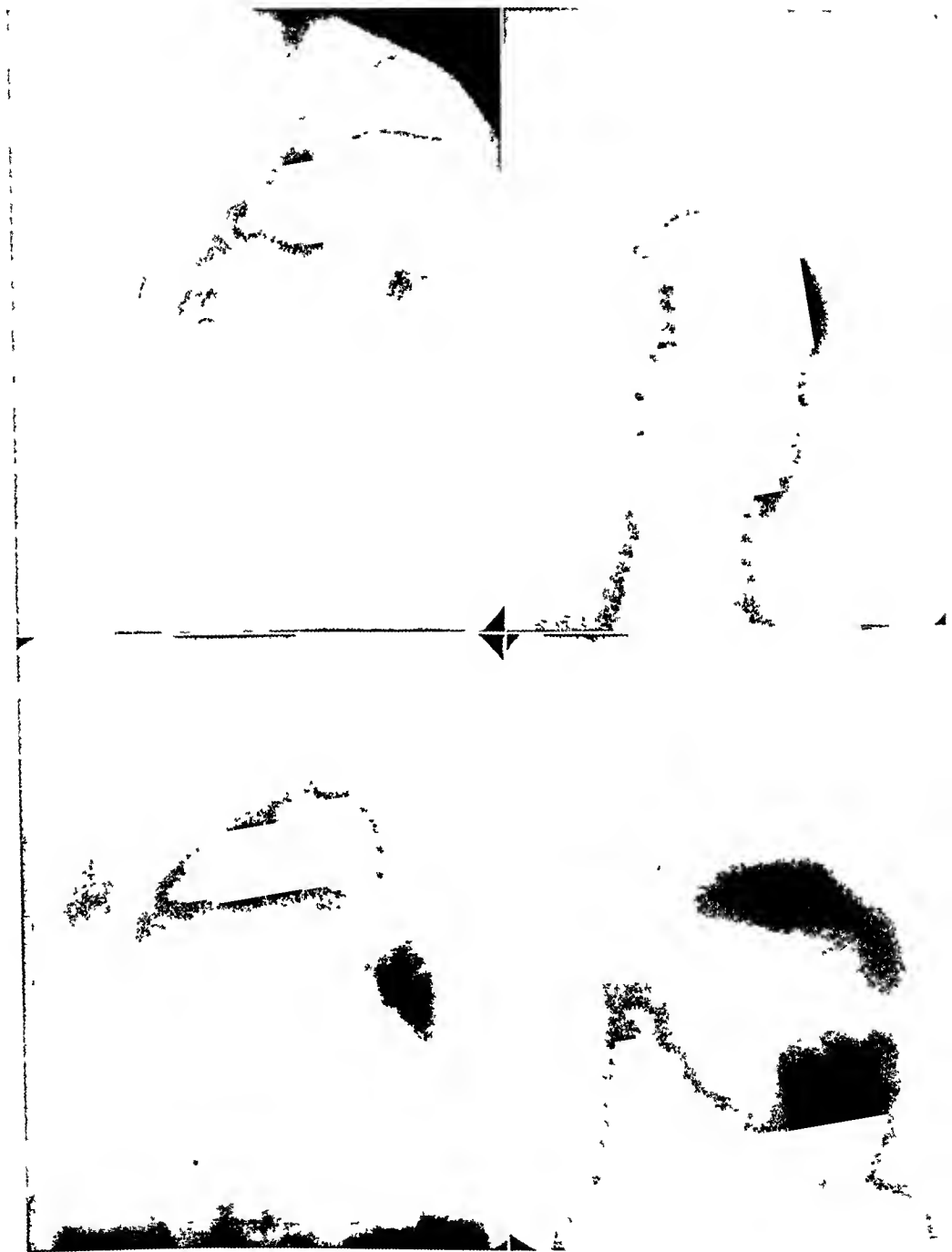


Fig 10-A (anterior view). The greater curvature of the pylorus is ill defined. The duodenojejunal flexure is displaced downward and is obstructed (*Upper left*)

Fig 10-B (left lateral view). The stomach is displaced upward and forward due to a pancreatic tumor (*Upper right*)

Fig 11-A (anterior view). A deformity along the greater curvature of the stomach. The duodenojejunal flexure is displaced downward (*Lower left*)

Fig 11-B (left lateral view). The stomach is displaced upward and forward. The posterior wall is deformed due to a pancreatic tumor (*Lower right*)



Fig. 14-A (anterior view). The upper half of the stomach is obliterated. (*Upper left.*)

Fig. 14-B (right lateral view). The upper half of the stomach is displaced backward due to a large tumor of the left lobe of the liver. (*Upper right.*)

Fig. 15-A (anterior view). The pyloric end of the stomach is obliterated. (*Lower left.*)

Fig. 15-B (right lateral view). The position of the stomach is normal. The duodenum describes a large arc, evidently due to enlarged head of the pancreas. (*Lower right.*)

the above case, namely, that forward and upward displacement of the stomach associated with downward displacement of the duodenojejunal flexure could take place only as a result of pressure from outside the stomach and duodenum, and since the pancreas is behind the stomach and above the duodenojejunal junction, a tumor of this organ would produce such an alteration in the position of the stomach. Hence a diagnosis of cancer of the pancreas, with infiltration of the posterior wall of the stomach, was made. This was confirmed by operation.

The above two cases presented no clinical symptoms or physical signs suggestive of cancer of the pancreas. If one were to depend upon the anterior view alone, a diagnosis of tumor of the pancreas would be impossible. By the use of the lateral view and a careful analysis of the relation of the organs a correct diagnosis was the result.

Case 12 (Figs. 12-A and 12-B). Male, age 45, was recommended for an X-ray examination because of a palpable tumor in the region of the epigastrium which was thought to be a gastric tumor. The anterior view (Fig. 12-A) showed obliteration of the pyloric end. The cardiac portion was found to be displaced to the left and the duodenum to the right. The duodenojejunal flexure remained in normal position. In the right lateral view (Fig. 12-B) the stomach and duodenum were found to be displaced forward. No abnormal changes were noticed in the contour of the stomach or duodenum. A diagnosis of a retroperitoneal tumor was made. The patient was subjected to a series of X-ray treatments, with complete disappearance of the newgrowth and the return of good health.

Case 13 (Figs. 13-A and 13-B). Female, age 53, complained of gastric disturbances. An X-ray examination of the gastro-intestinal tract revealed obliteration of the pyloric end, with displacement of the cardiac end of the stomach to the left (Fig. 13-A). In

the right lateral view the stomach was found to be displaced backward, with the anterior wall of the stomach compressed but with a regular outline. Since the left lobe of the liver is in front of the stomach, an enlargement of the liver would naturally result in such a displacement and compression. The diagnosis of hypertrophy of the liver fully agreed with the clinical and physical signs.

Case 14 (Figs. 14-A and 14-B). Male, age 31, presented a palpable tumor in the left hypochondrium. The anterior view (Fig. 14-A) showed almost complete obliteration of the upper portion of the stomach. In the left lateral view (Fig. 14-B) the upper portion of the stomach was found to be displaced backward by a large mass in front of it. The presence of a tumor in the left hypochondrium may originate from one of several organs, namely, spleen, left kidney, pancreas, or liver. In the case of a tumor of the spleen, kidney, or pancreas the stomach would be found to be displaced forward, since they are located behind the stomach. In the case of the liver the opposite would be true, since the left lobe of the liver is in front of the stomach. Hence, a diagnosis of tumor of the left lobe of the liver was made. This was confirmed by operation.

Case 15 (Figs. 15-A and 15-B). Male, age 63, complained of gastric symptoms. An X-ray examination of the stomach revealed complete obliteration of the pylorus in the anterior view (Fig. 15-A). In the right lateral view (Fig. 15-B) the stomach and duodenum were found normal in position and shape. A diagnosis of a normal stomach and duodenum was confirmed by operation on the gall bladder.

The above four cases show how often it is difficult to differentiate between deformities of the stomach produced by the neighboring organs and those originating from the stomach proper. By means of the lateral view it is possible not only to exclude

THE STORY OF THE FIRST ROENTGEN EVIDENCE

By SANFORD WITHERS, M.D., DENVER, COLORADO

IT IS my intention to present to you a description of the principals and to some extent the scene in the courtroom where the first X-ray plate was introduced as evidence. Try to visualize my description of a courtroom well filled with prominent people in an action for alleged malpractice in the treatment of a fractured femur against a surgeon of national reputation. This surgeon was, and still is, eminent. He was the first to do an appendectomy in this country; the first to accomplish an anastomosis of the spinal accessory to the facial and descending hypoglossal nerves; a man who has simplified many of our extensive surgical procedures; one of the founders of the American College of Surgeons and the Western Surgical Association, and a member of the Board of Governors of the College of Surgeons.

Defending this suit were a United States Senator, former judges and other attorneys with distinguished records, known throughout this country. The suit was brought April 14, 1896, by one James Smith, a poor boy who was reading law and doing odd jobs to pay his expenses. He was injured in a fall from a ladder while trimming some trees, and after some time he consulted the distinguished surgeon, who made no attempt at immobilization of the thigh but advised exercise of various kinds as though treating a contusion. Prosecuting this suit for James Smith, plaintiff, were Ben B. Lindsey, a young attorney in his early twenty's, and his associate, Fred W. Parks. We have all come to know the name of Ben B. Lindsey as the founder of the Denver Court of Domestic Relations—otherwise known as the Denver Juvenile Court. It is remarkable, too, that Mr. Parks later be-

came the youngest Senator in this State and had a varied and interesting political career.

The docket number of this case is 24,159 in the District Court of Arapahoe County, now the District Court of Denver, Colorado. At that time there was only one higher court in Colorado, the Appellate Court. On the day in question, Thursday, December 2, 1896, there sat upon the bench Judge Owen E. Le Fevre, a man who had made a considerable fortune in mining, who had been a lawyer whom every one trusted, who loved horses, sports, and his fellow-men—Judge Le Fevre, large of build and short in stature, with a very large head and a mass of snow-white hair, a closely clipped white mustache, and exceedingly pink face.

The young attorneys, Lindsey and Parks, qualified one H. H. Buckwalter as an expert in photography and in the use of roentgen rays, for he had been making X-ray shadow-graphs for the past eight months for his own amusement and that of his friends. He, with Dr. C. E. Tennant, of Denver, had become acquainted with Roentgen's work and, after similar experiments, agreed to attempt to take a picture of the hip of James Smith. Plates were made November 7, 11, 21, and 28, 1896. The most satisfactory one required an exposure of eighty minutes (personal communication from Dr. Tennant).

Judge Lindsey says that he had been in personal communication with judges in the East who had refused to accept X-ray plates as evidence, and that one of them had stated to him that he had sustained an objection to offer the X-ray plate in evidence "because," said he, "there is no proof that such a thing is possible. It is like offering the photograph of a ghost," continued the

the stomach, but also to determine the exact organ involved in the pathologic process.

CONCLUSIONS

1. The lateral view of the stomach, either left or right, will often disclose the presence of a deformity in the contour of the stomach which fails to show in the usual anterior or posterior views.

2. The lateral view of the stomach will help to determine the exact origin of a deformity which is recognizable in the anterior or posterior views.

3. The right lateral view of the stomach and duodenum will enable one to visualize the duodenum in its entire course, when it

is obscured by the pylorus and any abnormal changes brought into view.

4. The lateral view of the stomach and duodenum will enable one to differentiate between intrinsic and extrinsic lesions affecting the stomach or duodenum, and, if extrinsic, to enable one to determine the exact location and probable nature of the lesion.

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 2. Idem: The Value of the Lateral View of the Abdomen, with Special Reference to the Differential Diagnosis of Abdominal Tumors. *Cincinnati Jour. Med.*, May, 1928.
 3. Idem: Malposition of the Stomach and Bowel. *Jour. Am. Med. Assn.*, Oct. 20, 1923, XCI, 1184, 1185.
-

of an object unseen by the human eye, there is no evidence that the photograph accurately portrays and represents the object so photographed. This rule of law is well settled by a long line of authorities and we do not dissent therefrom as applied to photographs which may be seen by the human eye. The reason of this salutary rule is so apparent to the profession that as a rule of evidence we will not discuss it.

We, however, have been presented with a photograph taken by means of a new scientific discovery, the same being acknowledged in the arts and in science. It knocks for admission at the temple of learning; what shall we do or say? Close fast the doors or open wide the portals?

These photographs are offered in evidence to show the present condition of the head and neck of the femur bone, which is entirely hidden from the eye of the surgeon. Nature has surrounded it with tissues for its protection and there it is hidden; it cannot by any possibility be removed nor exposed that it may be compared with its shadow as developed by means of this new scientific process.

In addition to these exhibits in evidence, we have nothing to do or say as to what they purport to represent; that will, without doubt, be explained by eminent surgeons. These exhibits are only pictures or maps to be used in explanation of a present condition, and therefore are secondary evidence, and not primary. They may be shown to the jury as illustrating or making clear the testimony of experts.

The law is the acme of learning throughout all ages. It is the essence of wisdom, reason, and experience. Learned priests have interpreted the law, have classified reasons for certain opinions which, in time, have become precedents, and these ordinarily guide and control especially trial courts. We must not, however, hedge ourselves round about with rule, precept, and precedent until we can advance no farther; our field must ever grow, as trade, the arts, and science seek to enter it.

During the last decade, at least, no science has made such mighty strides forward as sur-

gery. It is eminently a scientific profession, alike interesting to the learned and unlearned. It makes use of all science and learning. It has been of inestimable service to mankind. It must not be said of the law that it is wedded to precedent; that it will not lend a helping hand. Rather, let the courts throw open the door to all well considered scientific discoveries. Modern science has made it possible to look beneath the tissues of the human body, and has aided surgery in telling of the hidden mysteries. We believe it to be our duty in this case to be the first, if you please to so consider it, in admitting in evidence a process known and acknowledged as a determinate science. The exhibits will be admitted in evidence

It is my pleasure to acknowledge the kind offices of Judge Ben B. Lindsey, the Honorable Fred W. Parks, Dr. W. W. Grant, Dr. C. E. Tennant, and Mr. Cornelius Westervelt for the data incorporated in this paper.

DISCUSSION

DR. I. S. TROSTLER (Chicago): Dr. Withers' paper is of great interest because of its historic value. It gives in detailed particulars what is surely the first instance in the United States, if not in the world, wherein roentgenograms were introduced as evidence before a court of justice. This history of our work has been most interesting to me, and, while I knew something of this Colorado case, I did not know the details and am very glad that Dr. Withers gave them to us in manner and form as he has done.

Radiological history is being written every day, but much more of the record of events which transpired thirty or thirty-five years ago should have been written at the time. I have found such records much in demand, having, during the past month, had numerous requests for reprints of a brief historic outline of some interesting events in radiology which I presented before the Section on Radiology at the 1930 meeting of the Illinois State Medical So-

judge, in his opinion, "when there is no proof that there is any such thing as a ghost."

In order to convey the idea of radiographic shadows to the judge and jury, Buckwalter, Lindsey, and Parks contrived a shadow box by means of a box with a small hole at one end through which illumination came from a lighted candle casting a shadow upon a screen at the opposite end of the box. They first showed the shadow of a hand. This was viewed by the jury and then an X-ray shadowgraph of a hand was shown. X-rays of other objects, such as small wheels of a clock, etc., were shown to the judge and jury. Next a normal femur was shown, its shadow being projected onto the screen by the light of the candle. Then the roentgen shadowgraph of such a femur was shown, and, finally, there was shown the X-ray plate taken of James Smith's left femur in the region of the hip joint. This radiograph showed that the head of the bone was not in normal relation to the great trochanter and shaft, and it was proposed by Lindsey and Parks that this radiograph, "shadow picture," or "roentgen picture," as it was called, be submitted to the jury as evidence that there had been a fracture of the femur in the region of the great trochanter, with impaction of the fragments.

The late United States Senator from Colorado, Charles J. Hughes, who was considered the most brilliant lawyer Denver ever had, argued for the defense for more than three hours against the admission of such evidence, stating that "X-ray photographs" are not admissible under the law, and past decisions of the courts bore this out. He contended, furthermore, that even should it be admitted that this was a photograph of James Smith's femur, it could not be used as competent testimony under the broad principle of the law upon the matter of photographs as testimony, that witnesses must testify to having seen the object which

has been photographed and to having identified the photograph as a good likeness of the object—then only may any photograph be admitted as evidence. This argument for the defense had taken the entire afternoon and Judge Le Fevre informed the attorneys that he would rule the following morning on the matter of the several X-ray plates taken November 7, 11, 21, and 28, 1896, purporting to show the deformity of James Smith's femur.

There was a large crowd in the courtroom when Court convened at 9 o'clock the next morning, for the papers had printed the story of how the X-ray equipment and Crookes' tube had been produced in the courtroom and explained to the jury, and that actual X-ray photographs of the bones in the human body had been shown openly in court. This paraphernalia had made a profound impression on the newspaper men who published the whole story prominently in the morning papers.

In telling of this Judge Lindsey states: "The electrical apparatus, batteries, Crookes' tube, etc., were all in the courtroom. We offered to show the jury the bones in their hands, which created such terrific excitement about the courthouse that extra bailiffs were called in to keep the court in order during the argument. The excitement was intense, the 'gallery' all on my side, restrained from breaking into applause on several occasions because of their anxiety to have this 'miracle' demonstrated and actually recognized by a court."

The following is a verbatim copy of Judge Owen Le Fevre's opinion on the exhibits, consisting of four X-ray plates, as handed down (*Denver Republican*, Thursday morning, December 2, 1896):

The defendant's counsel objected to the admission in evidence of exhibits, the same being photographs produced by means of the X-ray process, on the ground that, being photographs

ogists, and only graduates in medicine who can qualify as such, should make radiographic examinations."

I owe you an apology for reading you a lesson in the course of a discussion of a fine

historic paper such as Dr. Withers has presented, but I cannot help making a practical application of what is an extremely interesting and valuable contribution to the literature of radiology.

The Legal Aspects of X-ray. S. W. Donaldson. Jour. Michigan St. Med. Soc., October, 1930, XXIX, 700.

The legal aspects of the X-ray are more or less confined to three main divisions, namely: (1) Liability arising out of the use of the X-ray, either for diagnostic or therapeutic purposes; (2) liability arising out of failure to use the X-ray, and (3) the X-ray films as evidence. The State and Federal rule regarding physicians in general is as follows: "A physician is bound to bestow such reasonable and ordinary care, skill, and diligence as physicians and surgeons in the same neighborhood, in the same general line of practice, ordinarily have and exercise in such cases." "In the case of a specialist, the standard would be ordinarily that possessed by practitioners devoting special attention and study to the same branch in similar localities, having regard to the present state of medical science."

Most malpractice cases fall under the head of negligence, but there are three other sources of liability which must be remembered: (a) Cases in which the operator guarantees no harm; (b) the fact that the X-ray is inherently dangerous, and (c) the danger of electrocution from high tension current.

The insurance companies carrying malpractice insurance now have a clause in their policies stating that they are not liable for suits

brought about by damages after the X-ray has been used for therapeutic purposes. In some instances, the presence of an X-ray burn has been satisfactory evidence that negligence did exist, the argument evidently being that no burn will result from proper equipment properly used, but generally this rule of "*res ipsa loquitur*" does not constitute evidence that negligence did exist. Failure to use the X-ray has been the basis of several suits, and the general principles of the practice in the community usually govern in such suits. With regard to radiographs as evidence, the courts have apparently transferred bodily the rules relative to photographs, and the general tendency is to refer to them as secondary evidence. Undoubtedly there has been a great abuse of the X-ray in the court room and incompetent evidence has been allowed, due to the fact that unskilled men have misinterpreted the findings disclosed. Some courts have given the proper ruling in this connection, one stating as follows: "I do not think the doctrine that an ordinary photograph is the best evidence of what it contains, should be applied to the X-ray films. They constitute an exception to the rule concerning ordinary documents and photographs, for the X-ray films are not the best evidence to laymen of what they contain. The opinion of the expert is the best evidence of what they contain—the only evidence."

W. W. WATKINS, M.D.

ciety and which was published in the *Illinois Medical Journal* (November, 1930).

In Dr. Francis Williams' monumental work on "The Roentgen Rays in Medicine and Surgery," the first edition of which was published in 1901 (2d edition in 1902, only five months later), these facts were not recorded. This apparently well-informed author said: "There is, I think, no question but that radiographs will eventually be admitted as evidence by the courts, and they can make some doubtful points perfectly clear."

In the December, 1903, issue of the *Brooklyn Medical Journal*, Hon. W. W. Goodrich, Chief Justice of the Appellate Division of the Supreme Court of the State of New York, mentions a summary of the case described by Dr. Withers, which was published in the *Chicago Legal News*.

Probably one of the most celebrated cases in the United States (although not the first) in regard to the admission of roentgenograms as evidence is that of *Bruce vs. Beall* (99 Tenn. 303), which was decided on Sept. 30, 1897. Judge Beard, who wrote the decision for the Supreme Court of Tennessee, said: "In the progress of the trial, one, Dr. Gattman, was introduced as a witness, and he was permitted to submit to the jury an X-ray photograph taken by him, showing the overlapping bones of one of the plaintiff's legs, at a point where it was broken by this fall. This was objected to by the defendant's counsel. This picture was taken by the witness, who was a physician and a surgeon, not only familiar with fractures, but with the new and interesting process by which this particular impression was secured. He testified that this photograph actually represented the condition of the leg at the point of the fracture in question, and, as a fact, that by the aid of X-rays he was enabled to see the broken and overlapping bones with his own eyes, exactly as if, stripped of the skin and tissues, they were uncovered to the sight. We might, if we desired, rest our conclusion on the general character of the exception taken to this testimony, but we prefer to place it on the ground that, verified

as was this picture, it was altogether competent for the purpose for which it was offered. New as this process is, experiments made by scientific men, as shown by the record, have demonstrated its power to reveal to the natural eye the entire structure of the human body, and that its various parts can be photographed as its exterior surface has been and now is."

In the early years of roentgenography, there were quite a number of decisions against the admission of roentgenograms as evidence. Some of these were in Massachusetts, New York, Ohio and elsewhere, but soon the light of sense and justice prevailed and roentgenograms were admitted.

April 16, 1920, I presented a paper entitled, "An Important Supreme Court Decision" before the Chicago Medical Society, which was published in the *Illinois Medical Journal* (August, 1920), wherein I discussed a decision by the Illinois Supreme Court relative to a case wherein roentgenograms of a skull were submitted by a dentist who made them. The Court said:

"Some witness must be able to testify that the picture offered in evidence shows accurately what the witness saw when he looked into the body with the fluoroscope or he must be able to say that he is skilled in the use of the X-ray machine and in taking and developing X-ray pictures and that he took the picture offered in evidence with the body in a certain position (describing it) with a machine which he knew to be in good working condition and accurate, and that from his experience he was able to say that the picture produced by the machine was an accurate picture of the internal condition of the body." The judgment for the plaintiff in this case (*Roscoe Stevens vs. The Illinois Central Railroad Co.*) was reversed because the dentist did not and could not qualify properly according to the foregoing requirements.

In that paper I said: "Here is a decision from our own Supreme Court, which verifies and backs up what radiologists have been trying for a long time to impress upon those referring X-ray work—that expert radiol-

II. EFFECT OF POSITION OF CHAMBER DIAPHRAGM WITH RESPECT TO THE COLLECTOR ELECTRODE—AIR ABSORPTION

From a previous analysis by Taylor of the ionization chamber diaphragm system,⁶ the effective ionization E , in the chamber, is given by

$$E = \frac{\pi b^2 I_0}{B^2} L_0 \quad (1)$$

where I_0 is the X-ray flux density at unit distance from the focus; L_0 the effective

lector electrode should remain constant, as this distance alone is varied, subject, of course, to the one assumption that the radiation be sufficiently penetrating to permit the loss by air absorption between tube diaphragm and collector electrode to be neglected. Failla⁸ did find, however, a decrease of some 5 per cent in the ionization currents as the distance from his chamber diaphragm to collector plate was increased from 40 to 110 centimeters.

He attributed most of this 5 per cent,

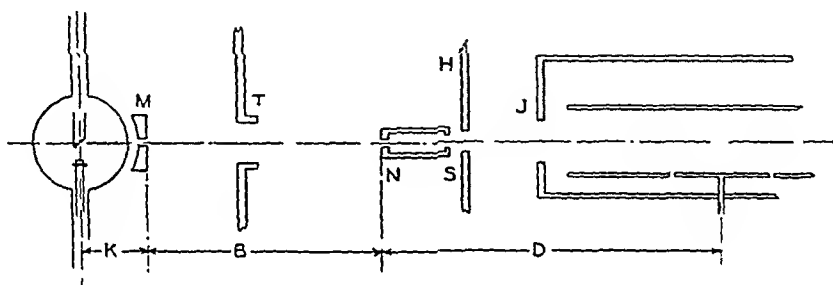


Fig. 1. Diagram of arrangement of ionization chamber and diaphragms used in studying air absorption.

length of the measuring electrode; B the distance between the tube diaphragm and the entrant diaphragm; b the radius of the chamber diaphragm, and π a constant. This condition holds only when the aperture of the diaphragm system is filled, and absorption and scattering in the intervening air space is negligible.

When using a small focal-spot tube, the focus may be considered a point (within certain ranges) so that B in the relation above is replaced by $B + k$ where k is the distance from focus to tube diaphragm.

Under these conditions the distance between the chamber diaphragm and collector plate should not enter.⁷ Consequently, we are led to expect that for a given beam of radiation the ionization currents to the col-

change to scattering from the lead walls of the tube which supported the diaphragms although later work on his and our part indicates that the effect was probably largely due to air absorption.⁹

A rough test of this effect, made at the time our free air ionization chamber was designed,¹⁰ showed a negligible change in the ionization current when the distance between chamber diaphragm and collector plate was kept within a working range suitable to our apparatus of from 30 to 45 centimeters. Where the collector to chamber diaphragm distance runs to magnitudes much above this, as in Failla's experimental case, the consequent air absorption should be taken into account as shown below. To

⁶L. S. Taylor, Bureau of Standards Jour. Research (R. P. 119), 1929, 111, 807; RADIOLOGY, July, 1930, XV, 49.

⁷This conclusion is in agreement with Behnken's earlier analysis (H. Behnken, Strahlentherapie, 1927, XXVI, 79), but in discord with the work of Kaye and Binks (G. W. C. Kaye and W. Binks, Brit. Jour. Radiol., 1929, II, 553).

⁸See p. 61, Failla's paper, referred to in Footnote 1, p. 104.

⁹Dr. Failla has very kindly made certain of his unpublished data available to the authors. It is very gratifying to find that his measurements check ours as to the effect of air absorption.

¹⁰L. S. Taylor, Bureau of Standards Jour. Research (R. P. 56), 1929, II, 771; RADIOLOGY, April, 1930, XIV, 372.

FURTHER STUDIES OF THE X-RAY STANDARD IONIZATION CHAMBER DIAPHRAGM SYSTEM*

By LAURISTON S. TAYLOR and G. SINGER, Bureau of Standards, WASHINGTON, D. C.

Abstract.—Further studies have been made on the effect of the diaphragm system upon the calibration measurements made with the large free air ionization chamber. Air absorption coefficients were obtained, and it was found necessary to use these values to correct the ionization chamber readings. Calibrations of a thimble chamber, made with and without a restricting diaphragm close to the X-ray

tube, differ by several per cent. Dependent upon the position of the thimble chamber with respect to the tube target, the calibration may vary over a range of 10 per cent. When the radiation is not restricted by a diaphragm close to the tube, there may be a difference in the radiation quality received by the thimble and air chamber, as large as 10 per cent.

I. INTRODUCTION

SINCE the completion of some previous studies at the Bureau, of the experimental technic necessary to obtain what was believed to be a correct determination of the recently adopted unit of X-ray quantity, several features of our own work and also that of other investigators seemed to demand further study. Certain pronounced differences appear in the results obtained by various workers, but this is perhaps to be expected, for a careful analysis of the free air ionization chamber systems used by them leaves doubt as to whether or not the several systems should yield accordant measurements of the roentgen.

Failla's¹ thorough experimental study of the diaphragm system was carried out in a manner sufficiently different from ours to render it difficult to decide how well the respective conclusions agree. Ours² had a limiting diaphragm close to the X-ray tube and of such size as to cut off all stem and off-focus radiation, whereas Failla omitted this and, instead, placed a somewhat larger

diaphragm about 30 cm. from the target, which, therefore, cut off only the extreme stem radiation.³ Again, Failla, simulating conditions used in practice, apparently obtained a satisfactory determination of the roentgen with a system employing a single diaphragm but a different value with two diaphragms. We, however, were unable to obtain consistent results with a single diaphragm system.

Glasser, since the publication of his report on the X-ray standard ionization chamber,⁴ informs us that he has removed the diaphragm close to the tube and finds his unit of quantity unchanged thereby, thus differing in his findings from both Failla and us. Behnken,⁵ using a Metalix line focus tube of the 220 K.V. type, which does not demand a tube diaphragm, naturally employs a single diaphragm system.

In the present study, the effects of these different experimental conditions applied to our own system have been investigated. In addition, other geometrical arrangements of various free air ionization chamber systems have been studied.

*Reprinted from *Bureau of Standards Journal of Research*, 1931, VI, 219.

¹G. Failla, *Am. Jour. Roentgenol. and Rad. Ther.*, 1929, XXI, 47.

²L. S. Taylor, *Bureau of Standards Jour. Research* (R. P. 119), 1929, III, 807; *Radiology*, July, 1930, XV, 49.

³In this paper the term "stem radiation" includes that from the back of the target as well as the stem, unless stated otherwise.

⁴Otto Glasser and U. V. Portmann, *Am. Jour. Roentgenol. and Rad. Ther.*, 1928, XIX, 564.

⁵H. Behnken and R. Jaeger, *Strahlentherapie*, 1930, XXXVI, 778.

formula, $I = I_0 e^{-\mu x}$, fairly accurate values of the air absorption coefficients for the various qualities of radiation used. For the thickness x of the absorbing medium (air) we may use the difference between the two values of D at which the intensity

radiation, this error may be neglected as indicated by the fact that as the filtration of 140 K.V. radiation is increased from 0.25 mm. to 1.0 mm. of copper, the absorption coefficient decreases from 0.00035 to 0.00033 cm^{-1} only.

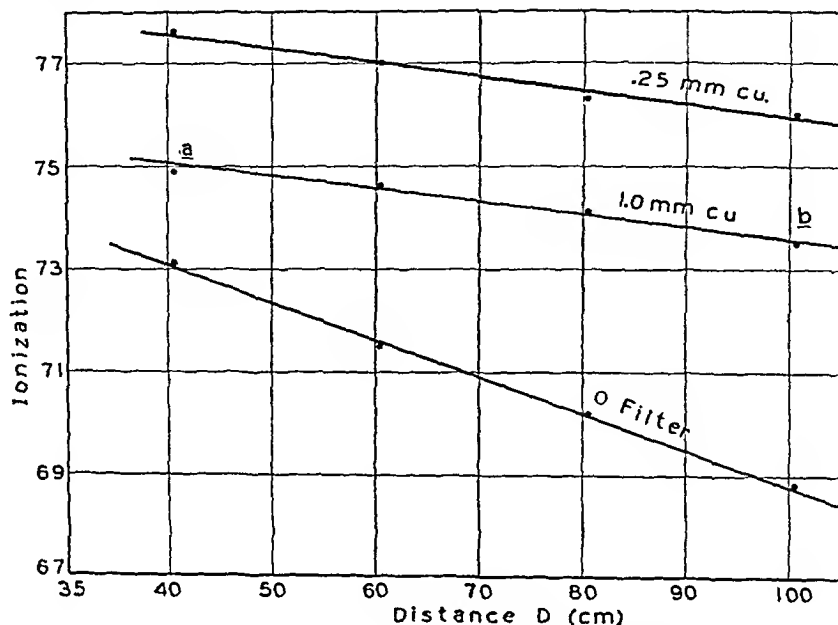


Fig. 2. Intensity of ionization as a function of the distance D .

measurements in Table I were made. The initial intensity I is taken as that for $D = 41.7$ cm. and the transmitted intensity through 60 cm. of air as that for $D = 101.7$ centimeters. Substitution of these values of I and I_0 in the equation gives, for each radiation quality, the absorption coefficients shown in Column 8.

It should be pointed out that for a very accurate determination of air absorption coefficients, it is undesirable to use such a great thickness of the absorbing medium, since there will be a slight change in the radiation quality due to absorption between the two positions of the ionization chamber used. This is, of course, more important for unfiltered radiation, and, consequently, the values of μ marked with an asterisk (*) in Table I should not be given as much weight as the other values. In the case of filtered

As known, the total absorption coefficient, μ , consists of two parts, σ and τ , such that¹²

$$\mu = \sigma + \tau$$

where τ is the true absorption coefficient and σ is the scattering absorption coefficient. If, now, σ is appreciable, the effective ionization per cubic centimeter in the ionization chamber should be perceptibly decreased by enlarging the cross-section of the beam in the chamber, either by changing the opening in the entrant diaphragm or by changing the distance D in either case, the intensity being kept constant. In an earlier contribution, using the same set-up, no such change was found by the authors,¹³ hence we may assume that σ plays no appreciable part here in decreasing the ionization observed.

In seeking to compare these results with

¹²See A. H. Compton, "X-rays and Electrons," p. 175.
¹³See Footnote 2, on page 104.

TABLE I

No.	Tube	K.V.	Filter	Distance <i>B</i>	$I_{\max.}$ $D = 41.7$	$I_{\min.}$ $D = 101.7$	Difference	Average deviation from mean	μ cm.^{-1} $\times 10^{-3}$
		1	2	3	4	5	6	7	8
			mm. Cu				Per cent	Per cent	
1.....	A	140	0.00	62.2	73.1	68.8	6.00	0.26	99*
2.....	A	140	.25	62.2	38.8	38.0	2.08	.51	35
3.....	A	140	1.00	62.2	19.55	19.17	1.96	.31	33
4.....	B	133	.00	40.5	63.69	60.55	3.40	.28	84*
5.....	B	133	.10	40.5	63.41	61.62	2.86	.30	46
6.....	B	133	.25	40.5	75.03	73.03	2.33	.46	44
7.....	B	133	1.00	40.5	26.11	25.69	1.65	.36	27
8.....	B	112	.25	40.5	42.37	41.26	2.63	.....	45

Note: See explanation of asterisk (*) in Column 8, on page 107.

test the effect of air absorption more carefully, it was decided to repeat these measurements over a wider range of distances between chamber diaphragm and collector, and, in addition, for several radiation qualities.

For this purpose the ionization chamber diaphragm, consisting of both the limiting (*N*) and the scattering (*S*) diaphragm, was removed from the chamber and supported rigidly in the center of the beam as indicated in Figure 1. The size of the diaphragm *N* and its distance from the tube diaphragm *M* were so adjusted that the diameter of the beam was small. The opening *J* in the front of the chamber was about 8 cm. in diameter, while the maximum diameter of the beam was about 3 cm., so that, proper alignment having been assured, no part of the beam was cut off. These features were each checked by means of a fluorescent screen. Finally a lead screen *H* was placed so as to prevent scattered radiation, from any preceding parts of the system, entering the chamber.

Maintaining *B* constant, the ionization chamber was moved along a track, in the direction of the beam, through a variable range from $D = 41.7$ cm. up. All other factors remaining constant, the resulting ionization currents in the chamber were

measured by a null method,¹¹ precautions being taken to insure that the X-ray beam did not pass so near to the electrode as to exclude utilizing the full range of the photoelectrons.

Figure 2 shows the plot of a typical set of such measurements, from which it is seen that the intensity of the beam falls off several per cent as the distance *D* is increased. It is also seen that as the radiation is hardened by increasing the filtration, the absorption per unit distance becomes less.

Table I gives the results of several sets of such measurements. Columns 4 and 5 indicate, respectively, the maximum and minimum ionization currents obtained at $D = 41.7$ cm. and $D = 101.7$ cm., represented by (a) and (b) in Figure 2. The percentage change in the measured ionization current appears in Column 6 and the average deviation from the mean of the observations for a single run, in Column 7.

The change in ionization current with increasing *D*, which is relatively large for unfiltered radiation and only one-third as much for filtered radiation, indicates that the assumption of no loss by absorption along the path certainly does not appear justified.

From these measurements it is possible to calculate by means of the usual absorption

¹¹See Footnote 10, on page 105.

minute as measured by the air chamber. Columns 4 and 5 indicate, respectively, the number of roentgens per full scale for the thimble chamber electroscope, with M in and out. Column 6 gives the percentage differ-

the target or diaphragm T . Since thimble chambers all vary in construction, it is obviously unsafe to rely upon a calibration effected by a system which does not strictly limit the beam to focal radiation.

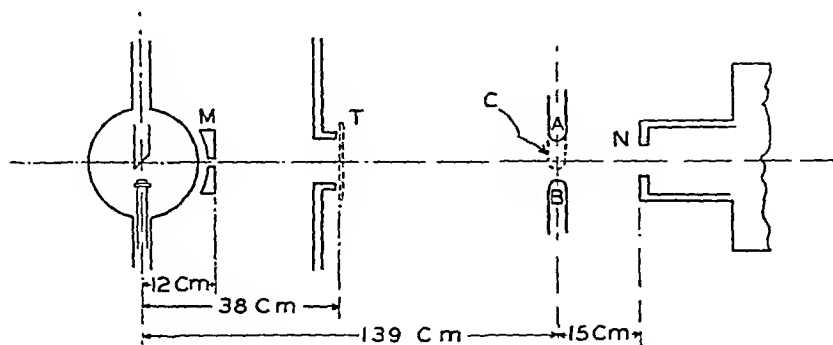


Fig. 3. Diagram showing arrangement of thimble chambers for calibration.

ence between the calibrations of the thimble chamber in the two cases.

It is seen that, as might be expected when the tube diaphragm M is omitted, the thimble chamber indications are in all cases larger than those of the air chamber, due to the fact that the former receives X-rays from a greater portion of the radiating source. Thus for calibration purposes it is obviously necessary that both chambers receive radiation from the same parts of the target.

The magnitude of such a variation depends upon the size and shape of the thimble chamber used and upon its distance from

IV. POSITION OF THIMBLE CHAMBER FOR CALIBRATION

As pointed out in a previous paper by the authors, different observers employ different methods of calibrating a thimble chamber against a standard.¹⁷ It was further shown that the replacement method was the most reliable. In view of the results of Section III, it was of interest to compare the three more common methods with the additional variable factor of changing the diaphragm M .

¹¹L. S. Taylor and G. Singer, Bureau of Standards Jour. Research (R. P. 169), 1930, IV, 631; RADIOLOGY, August, 1930, XV, 227.

TABLE III

[illegible]

TABLE II

K.V	Filter	r/mm	r/full scale M in	r/full scale M out	Difference = M in - M out M out
1	2	3	4	5	6
103	mm Al	165 176	3.02	2.99	Per cent +1.03
102	3	154 179	3.17	3.04	+4.27
85	0	9.35 11.93	3.18	3.10	+2.58
108	5	1.56 1.63	2.98	2.90	+2.76

previous work we find that reliable air absorption coefficients are not available. However, the use of a value of μ for air given by Eve and Day¹⁴ as 0.0004 cm^{-1} for roughly the same radiation quality corresponding to 112 K V radiation filtered with 0.25 mm of copper, results in a decrease in intensity of about 2.4 per cent per 60 cm as against 2.63 per cent found in our experiments. Considering the uncertainties in the earlier work this may be taken as fair agreement.

Having found that air absorption can not be neglected we should note the effect of this on the measurements made with large free air ionization chambers. In the chambers used by several observers the distance between chamber diaphragm and the collector plate varies from about 30 to 50 centimeters. Thus, if comparing two such chambers in which this difference is appreciably different, full allowance should be made for the air absorption of each quality of radiation employed in the comparison.

When calibrating a thimble chamber against a free air chamber, the former is usually placed at the position of the free air chamber diaphragm. Consequently the radiation, being partially absorbed within the large chamber, is more intense at the position of the small chamber than indicated by the measurements made with the large chamber. This may be corrected, by allow-

ing for the air absorption in the air path between the chamber diaphragm and collector.

In the guarded field ionization chamber, recently described by the authors,¹⁵ the distance between entrant diaphragm and collector is about 10 cm, consequently the error due to air absorption is reduced to about 0.4 per cent for filtered radiation. For the most precise work, however, this effect should be taken into account.

III. EFFECT OF DIAPHRAGM FOR LIMITING FOCAL RADIATION

The effect of omitting the diaphragm *M* placed next to the tube to eliminate stem and off-focus radiation was studied. Results were obtained most conveniently by comparing the ionization currents in two different chambers, both with and without the diaphragm in place.¹⁶

The method of observation was, first with the diaphragm *M* in place, to measure the intensity of the beam, with the large air ionization chamber and then with a thimble chamber placed at the position of the chamber entrant diaphragm; and, second, with the diaphragm *M* removed, to repeat these measurements. In the first case the stem radiation is cut off, under the second set of conditions, to simulate practice, the beam is limited by the diaphragm *T* having a diameter of about 4 cm, so that a portion of the stem radiation falls on the thimble chamber or entrant diaphragm of the standard chamber, both at 90 cm from the target.

Table II gives the results of a series of such measurements which happened to be made at lower voltages. Similar runs for higher voltages gave essentially the same results. Column 3 gives the roentgens per

¹⁵ S. Taylor and G. Singer, Bureau of Standards Jour. Research (R. P. 211), 1930, V, 507. *Radiology*, December 1930, XV, 637.

¹⁶ Obviously the magnitude of the difference between the ionization currents will depend in a large measure upon the particular choice of the chambers, and consequently such results have no quantitative value other than indicating the magnitude and direction of error.

V. VARIATION OF RADIATION QUALITY FROM DIFFERENT PARTS OF TARGET AND STEM

E. Lorenz¹⁸ found that the continuous spectrum radiation, produced by electrons striking the back of the target and stem after reflection from the target face, had a

chambers depends upon the radiation quality, it is important to know to what extent such a variation in quality exists.

To determine the magnitude of such quality change, three sets of conditions were chosen by shielding off certain parts of the

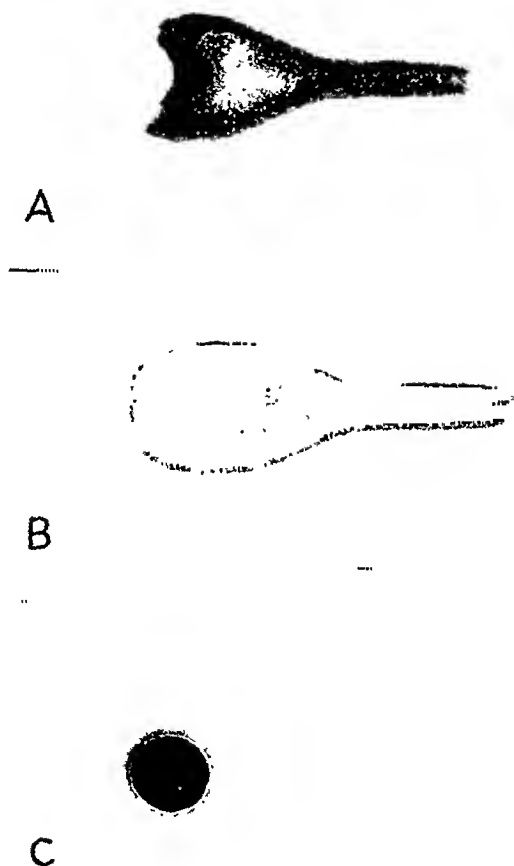


Fig. 4. Pinhole photographs of target (pinhole at position of diaphragm *T* in Figure 1). (*A*) Wedge placed to cut off focal radiation; (*B*) total radiation from anode; (*C*) focal radiation only, as limited by diaphragm *M*.

definite short wave length limit depending upon the position along the anode at which it was produced. This leads at once to the conclusion that the quality of the radiation from various parts of the anode other than the focal spot should vary over wide limits. Since the ionization measured by most small

radiation: (*a*) A thick lead wedge was so placed as to prevent all focal radiation from entering the air ionization chamber; (*b*) the wedge was removed, thus allowing the total radiation from focus, target back, and stem to enter the chamber; (*c*) the diaphragm *M* (Fig. 3) was placed in the beam and adjusted to such a size that only focal radia-

¹⁸E Lorenz, Proc. Nat. Acad. Sci., 1928, XIV, 582.

TABLE IV

 A' (stem—O. F.) B (F. + stem + O. F.)

Filter	I	I_2/I_1	μ	λ_e	I	I_2/I_1	μ	λ_e	$\Delta\lambda_e$
1	2	3	4	5	6	7	8	9	10
			cm.— ¹	Å.			cm.— ¹	Å.	Per cent
0.10.....	57.00				57.90				
.15.....	43.00	0.754	56.4	0.338	45.20	0.780	49.8	0.322	4.85
.20.....	35.30	.821	39.4	.296	38.70	.856	31.0	.272	8.45
.25.....	30.20	.856	31.0	.272	34.00	.878	26.0	.255	6.44
A (Stem + O. F.)					C (Focal)				
0.10.....	62.97				80.37				
.15.....	45.34	0.720	65.8	0.357	62.25	0.776	50.6	0.324	6.76
.20.....	36.26	.801	44.4	.310	52.90	.847	33.4	.280	10.16
.25.....	30.50	.841	34.6	.282	46.20	.873	27.2	.259	8.49
.30.....	26.40	.866	28.8	.265	42.00	.908	19.8	.230	14.10
.35.....	23.31	.882	25.6	.253	38.23	.910	18.8	.225	11.70
.40.....	20.86	.894	22.4	.241	34.96	.913	18.2	.222	8.19
.45.....	18.46	.884	22.6	.242	31.94	.914	18.0	.221	9.09

The experimental arrangement is indicated in Figure 3. A paraffin thimble chamber about 3 cm. long was placed successively in three positions: (*a*) to one side of the beam in the direction of the tube anode, (*b*) to the cathode side of the beam, and (*c*) in beam center, and for each position was calibrated in Section III against the large air chamber system with and without the diaphragm *M* in place. The thimble chamber and air chamber were placed 139 cm. from the target for Position *c*, but the air chamber was placed 154 cm. away for Positions *a* and *b*. In each case the alignment was tested with a fluorescent screen.

Columns 5 and 6 in Table III give the beam intensity in roentgens per minute as measured with the large air chamber with diaphragm *M* in and out, respectively. Columns 7 and 8 give the corresponding roentgens per full scale as measured with the thimble chamber. (The electroscope used in these measurements differed from that used in Section III and had greater sensitivity.) Column 9 indicates the percentage change in the ionization measured with the thimble chamber when the dia-

phragm *M* is removed. Rows 3 to 6 are seen to be in good agreement in this respect with the results given in Table II and further indicate that there is no essential difference in the calibration effected at positions in the center and at the cathode side of the X-ray beam. For both Positions *B* and *C*, the omission of the diaphragm *M* raises the thimble chamber measurements about 2 per cent, throwing the calibration in error by that amount.

However, Rows 1 and 2 for the thimble chamber in the anode side of the beam show that there is a very large decrease in the relative ionization measured when *M* is removed. The geometry of the system makes the reason clear; the diaphragm *T* shields the thimble chamber from a considerable portion of the stem radiation which is allowed to enter the large air chamber. We are thus led to the conclusion that, even without the diaphragm *M*, the most satisfactory position for the calibration of a thimble chamber is in the beam center, thus necessitating a replacement method of measurement.

INTRAVENOUS PYELOGRAPHY IN RENAL TUBERCULOSIS

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RENAL tuberculosis may be acute or chronic—part of a generalized tuberculosis or more or less localized in the kidney. If part of a generalized tuberculosis, the tuberculous process in the kidney consists of tubercles (few or many) in one or both kidneys, the result of a metastatic hematogenous infection. The tubercles implanted in the glomeruli cause invasion into the tubules, and, secondarily, the pelvis of the kidney, ureter, and bladder become involved in a descending tuberculous pyelonephritis.

Chronic local caseating cavernous tuberculous pyelonephritis may also result from an *ascending* tuberculosis from the bladder or prostate.

Primary renal tuberculosis is extremely rare—practically all cases are secondary to pulmonary or intestinal involvement.

In a well established case the renal pelvis may be shrunken but is usually dilated and the ureter is frequently found at autopsy to be as large as a man's thumb.

The symptoms of renal tuberculosis are insidious in their onset and not referable to the kidney until the disease is well advanced, but there may be a dull aching pain in the region of the kidney, lasting from one to three years, and accompanied by slight to moderate tenderness on pressure.

There are none of the usual symptoms of renal inflammation such as colic, with pain referred down along the ureter, unless the ureter becomes blocked, which usually does not take place until late in the disease. Chills, fever, sweats, emaciation are, of course, late symptoms. "Almost without exception, patients suffering with renal tuberculosis present themselves for relief from frequent and painful urination" (1).

Pyuria is always present, hematuria is less frequent, and the urine is usually strongly acid and of low specific gravity. Tubercle bacilli are found in the urine, either microscopically or by guinea pig inoculation, in 85 per cent of the cases, but this does not tell which kidney is involved. This can be done only by separating the urine from the two kidneys by ureteral catheterization.

"The bladder, even though the mucosa is not markedly involved, is extremely intolerant of any foreign medium introduced and therefore a general anesthetic is necessary for a complete cystoscopic examination" (Pilcher, 1). As stated above, renal tuberculosis is almost always secondary to pulmonary or intestinal involvement, and, in pulmonary tuberculosis especially, a general anesthetic is dangerous.

Ureteral catheterization may be necessary to the making of an accurate diagnosis, but the general anesthetic should be avoided.

Ascending pyelography is also a procedure that should be avoided, if possible. Kearns (2) reserves the ascending pyelogram for those cases in which the diagnosis is doubtful and refrains from injecting kidneys with advanced cavernous disease because of danger of rupture into the kidney substance. This contention is supported by O'Connor, Cabot, and Eberbach (3), and this opinion is also supported by most European urologists, who believe the dangers and disadvantages of ascending pyelography outweigh the advantages. Aside from the danger of dissemination, it is also unwise to subject these patients, who are especially upset by instrumentation, to the unnecessary shock. Any other method that will visualize the urinary tract and at the

tion entered the chamber. Figure 4 shows pinhole photographs of the target for each of the three conditions. Under each set of conditions the effective wave length was determined by the finite filter method,¹⁹ using a copper filter 0.05 mm. thick. (Since all effective wave lengths were measured by the same method there is no necessity for comparative purposes of reducing them to true effective wave lengths.)

The results of such quality measurements made with two X-ray tubes are shown in Table IV. A voltage of 130 K.V. ripple potential,²⁰ having very small ripple, was applied to the tube. Intensity measurements I were made with the free air ionization chamber for the different filtrations indicated in Column 1. The transmissions of 0.05 mm. copper for increasing initial filtration of copper are given in Columns 3 and 7. In Columns 4 and 8, and 5 and 9, are given the corresponding copper absorption coefficients and effective wave lengths.

Comparing the quality of the focal (C) and stem radiation (A) for the same filtration we find a marked variation between the effective wave lengths λ_e over the whole range studied. Column 10 gives the percentage difference in λ_e for the two beams. Likewise there is a large difference in quality between the stem (A') and the total radiation (B). (Data A' and B were for a fine focus tube, while A and C were for a broad focus tube of the same type, so that the two are not directly comparable.) However, it is seen that the change in λ_e for total (B) and stem (A') radiation is intermediate between zero change and that found for focal (C) and stem (A) radiation. This is to be expected, for in data B we have simply

an addition of a radiation of different quality to that corresponding to data A' .

Furthermore the distribution of scattered electrons over the back of the target and stem will vary both with filament current and tube potential; and, as a result, there will be a variable quality for the stem radiation dependent upon these factors. In general, this will affect seriously the calibration of a thimble chamber.

These results again emphasize the importance of limiting the standard X-ray beam to the focal radiation for which the quality is uniform unless all chambers receive radiation from exactly the same portions of the anode—an obviously impractical restriction.

It has been argued that, for purposes of medical application, the thimble ionization chamber should be calibrated under the same conditions as it will be subject to when used in practice; that is, exposed to the total radiation from the anode. This and previous studies by the authors show that such a method is impracticable if we are to measure X-ray intensity in terms of the international roentgen. Moreover, no errors will be introduced if the chamber is calibrated under experimentally ideal conditions and used in practice under very different conditions, provided care is taken to use the proper radiation quality. If a correct calibration is in roentgens under well-defined conditions, the thimble chamber will always indicate roentgens for beams of the same quality under which the calibration has been effected. For example, if a calibration be made for a quality λ_e where all the radiation comes from the focus, the chamber will indicate correctly for the same radiation quality λ_e , regardless of whether the source includes the stem as well as the focus. The effects of variations in the radiation quality due to the source are taken care of by the very nature of the primary calibration of a thimble chamber.

¹⁹L. S. Taylor, Bureau of Standards Jour. Research (R. P. 212), 1930, V, 517; RADIOLOGY, March, 1931, XVI, 302.

²⁰L. S. Taylor, Bureau of Standards Jour. Research (R. P. 217), 1930, V, 609; RADIOLOGY, June, 1931, XVI, 893.

and Swick, of New York, working in the clinic of Lichtwitz (Hamburg) clearly demonstrated that the urinary system could be visualized with this substance. The drug, however, caused nausea and headache, and a modification of the preparation was made which reduced the toxicity to such an extent that larger quantities could be tolerated and a higher concentration in the urine obtained. This preparation is now in use under the name uroselectan. It is non-toxic, easily soluble in water, contains 42 per cent iodine, and is excreted by the kidneys in sufficient concentration to give a good roentgenographic contrast with the ordinary and usual technic. It is apparently excreted through the kidneys unchanged in form—iodism has never been observed; therefore, it is harmless in tuberculosis.

The following directions are taken from Hirsch's (4) recent article in *RADIOLOGY*:

The technic of intravenous urography is extremely simple. The drug uroselectan is a powder put up commercially in forty-gram packages. The forty grams are completely dissolved by gradually adding them to 80 c.c. of previously heated, double distilled water. The volume is then made up to 110 cubic centimeters. It is filtered twice and then sterilized by heating it over a steam bath for twenty minutes. The solution, cooled to body temperature, should have a volume of 110 cubic centimeters. For obese patients, 60 grams are necessary. Three packages are then dissolved in 220 c.c. of water and 110 c.c. of the solution is used for a case. When cooled, the 110 c.c. is injected intravenously in two parts, with a syringe,¹ allowing a brief interval between injections. The injection is made in the X-ray department by a member of the department's staff. The simple procedure of the injection needs no elaboration. The patient has a sensation of warmth, particularly over the face and vesical regions. The subjective sensations are not at all uncomfortable—it is only to avoid any possible discom-



Fig 3. Case 2. Film taken 120 minutes after injection.

fort that the solution is injected in two parts. There is, however, no objection to injecting the entire 110 c.c. at one time. There are no after-effects whatever. After the radiographs have been made, the patient may resume his usual routine. The methods of oral and rectal administration give results inferior to those which may be obtained when the drug is administered intravenously.

The preparation of the patient is the same as for the usual roentgen examination of the urinary tract. The bladder is emptied and a preliminary roentgen examination is made before the uroselectan is injected.

Though the concentration of uroselectan in the urine varies, it is usually about 5 per cent. The roentgenograms, even in normal cases, have not, therefore, the photographic contrast obtainable with solutions in use for instrumental pyelography. In cases in which there is kidney damage, this contrast is still further diminished. A slight modification of the X-ray technic may, therefore, be necessary for good contrast.

The technic includes the customary immobilization, the use of the grid, and the usual urinary tract "set-up." The routine 14 × 17

¹The writers have found it more convenient to give the intravenous injection by the gravity method in one part, taking fifteen to twenty minutes to give the injection



Fig. 1. Case 2. Film taken 35 minutes after injection.



Fig. 2. Case 2. Film taken 90 minutes after injection.

same time obviate the necessity of a general anesthetic, the shock of instrumentation, and dangers of dissemination of the disease is indeed welcomed by urologists and those dealing with tuberculosis in general.

Intravenous pyelography affords such a method and it has been our good fortune to use it in five cases of renal tuberculosis. In all but one of these cases, the renal involvement was accompanied by more or less advanced pulmonary tuberculosis, with symptoms of active disease. In two of these cases, ascending pyelography had been attempted elsewhere without success and with decidedly harmful effects on the patients.

In reporting these five cases, it is not our purpose to draw any general conclusions (the number of cases is too small for that), but to demonstrate that the method is of value in visualizing the tuberculous kidney, ureter, and bladder and that it will at least show gross pathologic deformities in both kidneys and ureters. Some knowledge of the relative excretory power of the two kidneys can also be gained and a more satis-

factory knowledge of the extent of the lesions may be obtained. The method is simple, direct, and painless and in these five cases at least it has been absolutely harmless. There has not even been a transient increase in pulse or temperature in any of them. The only symptoms of reaction have been a sense of warmth and flushing a few minutes after the intravenous injection was started, pain in the arm on the side being injected in two cases, and a sensation of pain and fullness over the kidneys which lasted about an hour and a half in one case.

The substance used to visualize the urinary tract is known by the trade name of uroselectan and is indirectly the result of the successful research to obtain a contrast substance for visualizing the gall bladder by the X-ray.

Iodeikon, because of its high iodine content and excretion through the bile, makes the visualization of the gall bladder possible. Binz and Rath introduced another iodine compound—selectan neutral—that was excreted in large quantities through the urine.

regular pelvis of the kidney, together with a dilated ureter extending down as far as the crest of the ilium.

Third film (70 min. after injection): Patient was instructed to empty his bladder before this film was taken. On the right side there is a large dilated irregular pelvis with a dilated ureter extending down just below the crest of the ilium. On the left side there is nothing to be seen.

Fourth film (90 min. after injection): On the right side the kidney is clearly outlined and the dilated ureter can be seen extending all the way down to the bladder. Again, there is nothing to be seen on the left side.

Fifth film (110 min. after injection): This fifth film shows the same as the fourth, but not quite so sharply outlined.

Sixth film (130 min. after injection): The patient was instructed to empty the bladder before this film was taken. It shows the dilated pelvis of the right kidney. The ureter does not show except faintly in its lower portion in the region of the bladder. On the left side there is a faint streak-like shadow about the size of a pencil. This may represent a ureter.

Diagnosis.—Markedly pathologic kidney on the right side, with absent or markedly delayed functioning on the left.

Case 2. P. S. R., male, aged 29. There was generalized tuberculosis of both lungs, larynx, intestine, and epididymis, with fever, cough, expectoration, night sweats, marked frequency, and pain on urination. Ascending pyelography was extremely painful and the patient affirmed that he had been worse following the procedure.

Uroselectan was administered intravenously and films were taken at the following intervals:

Thirty-five minutes after injection (Fig. 1): There is a ragged shadow on the right side of rather unusual shape that may represent the pelvis of the kidney and the upper portion of the ureter, although this is



Fig 5. Case 3. Film taken 110 minutes after injection.

extremely problematical. On the left side the kidney and the calices are sharply outlined and the ureter is quite markedly dilated.

Ninety minutes after injection (Fig. 2): The same shadow as previously described on the right side is still present. On the left side the ureter is more distinctly outlined and there is a marked kink in its upper third. The bladder is quite well filled.

One hundred and twenty minutes after injection (Fig. 3): The shadow on the right side is still present and in none of the three films is the right ureter visualized. On this film there appears to be the outline of the right kidney markedly increased in size. The kidney on the left side is also increased in size. Dilatation and deformity of left kidney pelvis, dilatation and kink of left ureter, left pelvis and ureter unchanged since the 90-minute film.

Diagnosis.—Deformity of the left kidney pelvis, dilatation and kinking of left ureter. Almost complete absence of excretion from the right kidney.



Fig. 4. Case 3. Film taken 75 minutes after injection.

film should be supplemented by separate films of either or both kidneys, and the lower portion of the tract. Compression with the inflated bag or loofah sponge may be applied a short time before the exposures are made, though this is by no means essential. The roentgen study is a serial one.

The first urogram may be made fifteen to twenty minutes after the injection and a second exposure fifteen to twenty minutes later. The patient should be permitted to void after the second exposure. The withholding of urination over a long period is not necessary. Overdistention of the bladder hides the lower portion of the ureters. Three subsequent urograms may be made at intervals of fifteen to twenty minutes, making a total of five in all. If the visualization of the entire urinary tract on both sides is clear and definite in the first or in the second film, this may be considered sufficient, and the examination may be called complete. If, however, there is no visualization at first, it is necessary to make the entire set of five films.

In cases in which there is considerable renal dysfunction, clear visualization may not be obtainable until from six to twenty-four hours have elapsed.

It would appear that in actual practical work, three exposures, the first at fifteen, the second at forty-five, and the third at seventy-five minutes after the injection, will suffice.

The period of maximum visualization may be determined by fluoroscopic examination. Within five minutes after the injection the contrast substance may be visualized in the kidney, but the tract in its entirety cannot be visualized before twenty minutes have elapsed (4).

The more normal the renal function the greater the concentration, the more rapid the elimination, and the more clear the X-ray visualization. Therefore, the time of excretion and X-ray delineation constitutes a rough method of estimating the renal function on each side. Depending on the degree of renal destruction, there is poor or delayed or no visualization whatever. In our cases, even though marked deformity of the renal pelvis might be noted, the function in most instances was good. The ability of the tuberculous kidney to do its work in spite of severe anatomical changes is apparently remarkable.

CASE REPORTS

The following case histories, with their accompanying roentgenograms, are included to illustrate the method.

Case 1. J. F. H., male, 26 years of age, had predominant symptoms as follows: severe lumbar pain, nausea, cough, expectoration, elevation of temperature, and severe chills about every ten days to two weeks. Tubercle bacilli present in urine. Ascending pyelography unsuccessful.

Kidney X-ray examination after the administration of uroselectan intravenously. Films taken thirty, fifty, seventy, ninety, one hundred and ten, and one hundred and thirty minutes after injection.

First film (30 min. after injection): On the left side no density is noted. On the right side a rather smooth, dilated pelvis, with beginning filling of the ureter, is noted.

Second film (50 min. after injection): Nothing to be seen on the left side and on the right there is what appears to be an ir-

OBSTRUCTIVE LESIONS OF THE SMALL BOWEL¹

By C. H. HEACOCK, M.D., The Polyclinic, MEMPHIS, TENNESSEE

THE value of the roentgen-ray examination in the diagnosis of intestinal obstruction was first pointed out by James T. Case. During the last fifteen years he has written several papers on this subject and now it is almost impossible to make any observation not already described by

(1) Those in which a clear-cut, definite clinical diagnosis can be made and in which the findings localize the site of the obstruction.

(2) Those in which the clinical diagnosis is definite but in which there are no localizing symptoms or findings.



Fig. 1. Acute obstruction with typical herring-bone formation. At operation the obstruction was found to be due to a loop of bowel knotted beneath a band of adhesions



Fig. 2. Acute obstruction showing both the herring-bone and ladder patterns. Stricture of the ureter suspected and the roentgen findings were the first indication of obstruction.

him. His pioneer work did not receive the general acceptance and prompt adoption it deserved. During the last two years, however, the literature on the subject has been greatly augmented.

Cases of intestinal obstruction fall into one of the following groups:

¹Read before the Radiological Society of North America, at Los Angeles, Calif., Dec. 1-5, 1930, at its Sixteenth Annual Meeting.

(3) Those in which the diagnosis is uncertain.

(4) Those in which the diagnosis is not even suspected by the clinician.

Whenever there is any doubt about the presence or location of an obstruction, *i.e.*, in the last three groups, there is an indication for a roentgenologic examination. The extent of the examination and the amount



Fig. 6. Case 3. Film taken 175 minutes after injection.

Case 3. E. C. K., male, aged 32. No evidence of pulmonary tuberculosis on physical or X-ray examination. Prominent symptoms are painful and frequent urination, with constant pain over the bladder region, and occasional passing of bloody urine.

Cystoscopic Examination.—Highly inflamed bladder wall; ureteral orifices located but impossible to pass ureteral catheters. Urogram by intravenous method, with the following findings:

Thirty minutes after injection. There is considerable gas in the bowel, but, in spite of this, the kidney pelves on both sides seem to be tremendously enlarged. There is marked dilatation of the ureter on both sides.

Seventy-five minutes after injection (Fig. 4): The kidney pelvis on the right side is

markedly increased in size and this also applies to the left side, and the ureter is extremely irregular.

One hundred and ten minutes after injection (Fig. 5): The bladder has been emptied and the lower end of the ureter on the right seems to be about as large in circumference as a thumb.

One hundred and seventy-five minutes after injection (Fig. 6): The kidney pelves on both sides are still outlined and the ureters are quite distinct on both sides and markedly enlarged.

Diagnosis.—Marked deformity of both kidneys, partial obstruction and dilatation of both ureters.

CONCLUSIONS

It is not our purpose in presenting these cases to do other than show that the method is safe and painless in renal tuberculosis and that surprising anatomical changes, much more extensive than one would be led to believe from the symptomatology alone, can be noted in the kidneys in individuals with renal tuberculosis. A careful study of a larger number of cases, utilizing this new method in conjunction with the older chemical, functional, bacteriological, and anatomical methods, will most surely increase our knowledge of renal tuberculosis.

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- (3) Quoted by Kearns (2), which see.
- (4) HIRSCH, I. SETH: *Urography by Uroselectan*. RADIOLOGY, October, 1930, XV, 480.

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Fig 2 Acute obstruction showing both the herring-bone and ladder patterns. Stricture of the ureter suspected and the roentgen findings were the first indication of obstruction

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(3) Those in which the diagnosis is uncertain.

(4) Those in which the diagnosis is not even suspected by the clinician.

Whenever there is any doubt about the presence or location of an obstruction, *i.e.*, in the last three groups, there is an indication for a roentgenologic examination. The extent of the examination and the amount



Fig 3 Same case as shown in Figure 2. Barium had to be given to convince the clinician. Film, made in the erect posture, shows fluid levels. Diagnosis confirmed by operation.



Fig 4 Distended loops of small bowel in an infant 9 days old. Congenital absence of the colon. The loops show no herring-bone or ladder formation. This may be due to the fact that the mesentery is not completely developed.

of work required will depend largely upon how acute and how complete is the obstruction.

If the roentgen examination is to be of much benefit in the acute cases, it is of utmost importance that the examination be completed quickly and with minimal tax upon the strength of the patient. These acute obstructions usually develop soon after an operation. The patient is in a hospital and facilities for the examination are at hand. If the condition of the patient is satisfactory, the examination should be made in the laboratory where a motor-driven Bucky fluoroscopic table is available. It is important to make this examination in both the supine and erect positions, and with the motor-driven table both fluoroscopic and radiographic studies can be made without any exertion on the part of the patient. If the

patient cannot be removed from his bed, roentgenograms can be made in two planes without moving him and a great deal of information obtained. In acute cases, this usually represents all the work that is required and a report can be returned within from fifteen to thirty minutes after the examination has been requested. This procedure fulfills the requirements that no time be lost and the strength of the patient be conserved.

In cases of acute obstruction, the surgeon finds the lumen of the small intestines distended with gas and fluid proximal to the point of obstruction, and collapsed distal to this point. The roentgenologic diagnosis is based upon this same finding. While small amounts of gas may exist normally in the small bowel, the only collections of gas seen on the radiographs of normal individuals



Fig. 5. Distended loop of small intestine six hours after the ingestion of barium. Obstruction was caused by a mass of enlarged glands in a case of Hodgkin's disease.



Fig. 6. Same case as shown in Figure 5. The same loop of distended bowel twenty-four hours after the meal. This loop was not distended with gas on the preliminary film.

occur in the stomach and colon. Collections of gas in the small bowel are, therefore, always significant, and, when the additional signs of distention and fluid levels are present, definite criteria for the diagnosis of obstruction may be said to exist. The fluid may be easily overlooked unless the patient is examined in two planes, preferably the supine and the erect postures.

Usually the appearance and distribution of the gas enable the roentgenologist to determine its location. In the small bowel haustral markings are absent, while the valvulae conniventes stand out prominently. Case has described this appearance as the "herring-bone pattern." He has also described a "ladder pattern" in which the dilated loops of intestine show a tendency to arrange themselves in parallel rows, like the rungs of a ladder. He believes that the recognition of valvulae conniventes or Kerkering's folds in dilated, parallel loops of small

intestines should be construed as an indication for surgical intervention.

How soon does gas accumulate following an obstruction? Wangenstein and Lynch produced obstruction experimentally in dogs and made roentgenograms at frequent intervals. They found that gaseous distention of the obstructed loops began in from four to five hours. This distention was very marked on the roentgenograms in from twenty to twenty-four hours, although clinically no distention could be made out. They conclude that plain films of the abdomen afford the most reliable method of making an early diagnosis. Douglass believes the two patterns described by Case, while diagnostic, come rather late. He believes one or two distended loops, in the presence of clinical signs, complete the diagnosis. Rabwin also warns that obstruction which results in early gangrene may not cause dis-



Fig 7 Several areas of distended ileum separated by narrow zones of constriction. The diagnosis of dense fibrous bands of adhesions was confirmed at operation.



Fig 8 Annular carcinoma of the ileum causing marked distention and stasis. Note the annular shadows above the right ala of the sacrum due to grains of uncooked rice eaten twenty-eight hours before the examination.

tention with gas and that this type of obstruction may give negative roentgenologic findings.

In my experience, the herring-bone appearance and the ladder arrangement describe the appearance in adults very well. In the only two cases occurring in infants which I have had an opportunity to examine, these patterns were absent, although the loops of small intestines were distended. No explanation can be offered for this observation and perhaps a larger number would show these patterns to predominate also in infants.

Wangensteen and Lynch found it unnecessary to give barium to make the diagnosis in their experiments on dogs, but in those cases in which it was given, twenty hours were required for the barium to reach the point of obstruction. In cases of acute obstruction there is no time for a long study with barium, and this is fortunate, as its

administration increases the risk at the time of operation.

In chronic or partial obstruction there may be no distended loops of small bowel and no information obtained on what Davis calls the "scout film." In this type of case the administration of barium is necessary to make the diagnosis. It is also in this type of case that the diagnosis is most often doubtful and the need for immediate interference not so urgent. Within this group fall the neoplasms—both benign and malignant—and it must be remembered that the early detection and localization of the latter lesions determine the success of the treatment. The examination with the ingested meal, which may require forty-eight hours, is permissible. Thus far no untoward effects have been observed.

There are two reliable roentgen signs of

partial obstruction. One is dilatation of the lumen proximal to the obstruction and the other is a disturbance in motility. The slowing up and damming back of the current is manifest throughout the small intestine, and there may even be a gastric retention. The delay becomes progressively more pronounced until the point of obstruction is reached. After passing this point the normal progress of the meal is resumed. It is important for the roentgenologist to know the normal motility for the opaque mixture he is employing. This will vary somewhat, depending upon how much fat and carbohydrate are added to the barium. Delayed motility due to obstruction must not be confused with stasis in the small bowel without mechanical obstruction. Stasis usually occurs in the ileum and may be associated with no organic lesion. Lesions in the colon, especially the right half of the colon, must be ruled out and the possibility of a regurgitation through the ileocecal valve must be considered. The finding of barium at the twenty-four-hour observation is always significant and, in the absence of a lesion in the colon, generally means an obstructive lesion in the terminal ileum. While there is delayed motility in both stasis and obstruction in the former, dilatation of the lumen does not occur.

Practically all lesions of the small bowel which give positive roentgenologic findings manifest themselves in the same way, *i.e.*, by producing obstruction. Intestinal tuberculosis is a notable exception. However, there is usually no characteristic roentgen finding that enables the observer to tell the type of lesion present in a given case. I have seen intestinal obstruction following congenital malformations, adhesions, and neoplasms—tumors both intrinsic and extrinsic to the intestinal tract. Usually the latter displace the freely movable coils of small intestine and do not produce obstruction. I have seen two cases in which the ob-

struction was due to extrinsic pressure. One was in the retroperitoneal portion of the duodenum where the lumen of the bowel was occluded by the pressure from an aneurysm of the abdominal aorta. The other was from the enlarged mesenteric glands in a case of abdominal Hodgkin's disease.

Clinical aids and experience can sometimes assist in determining the type of lesion present. Paralytic ileus cannot be differentiated from mechanical obstruction by the radiograph alone; however, differentiation can be made by the radiograph plus the stethoscope. A questionable area can be palpated under fluoroscopic visualization and a mass found which otherwise may have escaped detection. If this mass is not the distended bowel but is situated just distal to it, a neoplasm is suggested. In one case in which there was a series of dilated coiled loops, separated by narrow zones of constriction, a diagnosis of fibrous bands of adhesions was confirmed at operation. The contention of Soper and Thompson that the dense fibrous bands of adhesions are the type most likely to produce destruction seems well founded, but, in the great majority of cases the roentgenologist should be content with merely reporting the presence and, if possible, the location of the obstruction.

Roentgenologists in general appreciate the possibilities of recognizing these lesions but they also know that the medical profession as a whole does not recognize and utilize this method as it should, especially in the acute cases. There is a tendency to overestimate its dangers.

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An account is given of a visit to various clinics in Paris of the Visiting Association of Throat and Ear Surgeons of Great Britain. Mention is made of a series of excellent cases which had been treated by deep X-ray therapy at the Radium Institute (Institut Curie). These comprised patients with malignant disease of the vertebral column, of the aryepiglottic fold, vallecula, epiglottis, tonsil, etc., several of whom had, in addition, secondary deposits in the neck. The results were very remarkable and all the patients exhibited had been free from recurrence for from five to seven years.

The details of treatment were discussed and it was said that in some cases as much as 37 hours of treatment, spread over 25 days (from one to two hours a day), was necessary. A sinus pyriformis case had 29 hours, spread over 33 days. It would appear that 28 per cent of intrinsic laryngeal cases do well. Extrinsic cases also do well but these may develop thoracic and abdominal metastases.

In addition, a series of patients who had previously had cancer of the tongue was exhibited. Drawings of the condition before treatment and microscopic slides showing the type of growth along with the details of actual radium treatment were also shown. There

were several cases in which the disease had been extensive, particularly one treated in 1923 by block dissection of the neck and subsequent radiation, in which there was no recurrence.

At the Hôpital Tenon, Dr. Hautant and his assistants showed many interesting operations, in which radium was used as an accessory to the ordinary surgical procedure. Amongst others were seen a partial excision of the superior maxilla for carcinoma of the alveolus and application of radium tubes to the pterygomaxillary fossa; also a carcinoma of the antrum which was being treated by resection of the anterior wall through a sublabial incision and, at the end, an insertion of three radium tubes into the cavity (7 millicuries for four days). The good results obtained by this procedure were illustrated by four patients in whom a similar operation and radium application had been made from three to five years previously, and in whom there was no recurrence.

At the Hôpital Laennec, a demonstration of X-ray films in mastoid disease, with temporotympanic exposure, was given. Dr. Clovis Vincent at the Lariboisière discussed the taking of roentgenograms of the skull in the antero-posterior direction and from above down, to show the petrous bones and internal acoustic meatus and the alteration of the affected one.

THE PATHOLOGY OF THE SMALL BOWEL, WITH SPECIAL REFERENCE TO X-RAY DIAGNOSIS¹

By JAMES L. McKNIGHT, M.D., TUCSON, ARIZONA

I PRESENT to you to-day no scientific treatise but just a review of some conditions which come to the roentgenologist in a small city far from the great medical centers and where there are few opportunities to come in touch with the leaders in our specialty.

More and more every year the surgeon and the physician are looking to the roentgenologist for aid in the diagnosis of disease. In no class of diseases is this more true than in those affecting the gastro-intestinal tract. Thanks to such men as Cole, Alvarez (1), Brown and Sampson (2) and others, we are now able to render much more help to the practitioner than was formerly possible.

To enter to-day into any extended discussion of the underlying principles of anatomy, physiology, muscular activity, and especially of the difficult problems of innervation, extrinsic and intrinsic, inherent contractility of muscle structure, sympathetic reflexes, association with diseases of the gall bladder and the appendix, is manifestly impossible. This you will find in the writings of such men as I have mentioned. Suffice it to say that diagnosis is made by observation of abnormalities in position, contour, and motility of the bowel.

Among the pathological conditions of the small bowel, I mention first that one which in frequency appears dominant, namely, duodenal ulcer. Whether or not we accept the so-called cap as the proximal part of the small bowel or the distal part of the stomach need not matter at this time. Here we have the most common site of intestinal ulcer. Dwyer and Blackford (3), in an analysis of three thousand cases presenting com-

plaints of digestive disturbance, found 15 per cent showing ulcer of the stomach or duodenum. Duodenal ulcer occurred five times more frequently than gastric ulcer. My own observation would put the ratio considerably higher but I have no exact figures to offer at this time.

The X-ray findings in duodenal ulcer are preëminently of two kinds: Disturbance of motility of the stomach and of the cap and filling defects and deformity of the cap. In many of these cases we find violent hyperperistalsis and very rapid, complete emptying of the stomach; in others, an early hyperperistalsis and rapid emptying, eventuating in exhaustion of stomach musculature and marked six-hour retention. In an old ulcer, with thickening, there may be extensive stomach retention and even dilatation and hypoperistalsis. The diagnosis of ulcer of the duodenum takes on great importance when we consider its frequency and gravity and the great need of appropriate treatment.

Next I call your attention to the diagnosis of tuberculous ulceration. We are prone to think only of large bowel involvement, but we must remember that in a large percentage of cases the small bowel also is involved. About 80 per cent of all terminal cases of pulmonary tuberculosis have a complicating ulceration of the bowel. After spending more than twenty years in tuberculosis work, I know of no means of diagnosis of tuberculosis of the bowel which will definitely separate the 80 per cent theoretically involved from the 20 per cent not involved, except by X-ray examination. The symptomatology of tuberculosis of the bowel is notoriously uncertain and misleading. Many cases are overlooked entirely and are found only at autopsy. I have seen at autopsy ex-

¹Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1-5, 1931.

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given sufficient attention by physicians and surgeons generally. Visceroptosis, I would divide into two classes: Clinical and non-clinical. Very often the patient is informed that ptosis is of no importance and requires no treatment. In what I class as non-clinical cases, this is, of course, true. However, there is a rather large percentage of these cases in which such a statement is not correct. In these, we have a duodenal stasis due to the dragging of the ptotic stomach on the relatively fixed duodenum. The victim of this condition is undernourished, unhappy, neurasthenic, lacking in energy, subject to dragging discomfort or actual pain at the site of the duodenum. It is useless to tell this type of patient that ptosis amounts to nothing. Such advice only drives him—or more often her—from doctor to doctor, in all probability to fall into the hands of quacks of one kind or another.

Beilin's (5) excellent article on this condition bases the diagnosis entirely on fluoroscopic and palpatory findings. My own conclusions, through force of peculiar circumstances, are based entirely on the radiographic evidence. His method may be better—either method brings one to the same conclusion. This type of case ought to have careful and persistent treatment.

I next refer to intestinal stasis due to peritonitis and cite a case representing tuberculosis of the peritoneum. The diagnosis in this case was confirmed by exploratory operation and at autopsy. In the film one could note the irregular filling and segmentation.

Diverticula of the small bowel are not very uncommon. I cite a case of diverticulitis involving the duodenum, in a patient, the wife of a physician, aged 60 years. There was no previous history of this condition and no previous radiographs had been made. The patient suffered from moderate pain, with some nausea. Recovery occurred after a few weeks of dietetic treatment and the symptoms have not returned. I might

cite another case of diverticulum at almost the exact location of the first. In this instance the patient is a cowboy on an Arizona ranch. The symptoms are much the same as described above.

I next call your attention to intestinal stasis due to extrinsic neoplasm. The patient, a little child, suffered intensely from vomiting, and when brought to the referring physician was in a very bad condition due to extreme dehydration and starvation. X-ray diagnosis of incomplete obstruction of the small bowel was made. For a time, improvement occurred under medical and dietetic treatment, but soon the symptoms recurred with great severity. Exploratory operation was done by Dr. C. A. Thomas, of Tucson, by whose courtesy this case is mentioned. Inoperable lymphosarcoma was diagnosed and the abdomen closed. Death of the child followed soon after.

A case of intestinal obstruction of unknown etiology is now cited, occurring in a child about ten years of age who suffered from epileptiform seizures. This case unfortunately drifted away from the referring physician and we were not able to determine the cause of the obstruction or to determine whether or not this condition had to do with epileptiform attacks.

Finally, I call attention to incomplete obstruction of the small bowel due to adhesions. The case cited has been of considerable interest inasmuch as there has been wide difference of opinion as to the exact nature of the pathology. The patient, a man about 50 years of age, has suffered for the past three and one-half years with rather frequent attacks of excruciating, paroxysmal pain, rather general over the lower abdomen but centering especially over the region of the cecum and terminal ileum. These attacks are peculiarly colicky in character and are accompanied with much gaseous distention not relieved by enema. The pains recur much like labor pains in a woman. Momen-

tremely advanced cases of tuberculous ulceration in which the only symptomatology had been a slight degree of constipation. The presence of diarrhea is suggestive but proves nothing. Pain and tenderness are usually present to some degree, usually not severe, most likely to be found in the lower right quadrant and possibly due to a chronic appendicitis, a condition very frequently present in tuberculous patients. So we cannot diagnose ulceration on the presence of pain. The presence of the tubercle bacillus in the stool proves nothing, of course. There is no clinical sign or symptom on which we can depend. True, in advanced, hopeless cases, the complex of symptoms is fairly conclusive, but by this time we are usually too late for effective treatment.

I believe that in no other disease can the roentgenologist be of more real value to the practitioner than in the early and definite diagnosis of tuberculosis of the bowel. Contrary to our former belief, this condition does respond to appropriate treatment and the patients do get well. The criteria for diagnosis of ulceration of the small bowel are essentially the same as in the large bowel; that is, irritability, intolerance of segments to the presence of the barium, spasticity, segmentation.

Following the methods laid down by Brown and Sampson (2), I consider the diagnosis of tuberculosis of the bowel one of the easiest and most accurate of all the conditions with which we have to deal in roentgenologic diagnosis. Dealing, as we do in Tucson, with a great number of tuberculous individuals, we have found the X-ray diagnosis of tuberculous ulceration of the bowel satisfactory and reliable and of extreme value to the patient, provided his pulmonary condition is not too far advanced and the ulceration not too widespread.

It has seemed to me that many of us have been too conservative—too timid, if you please—in the X-ray diagnosis of tuber-

culous ulceration. I have seen too many X-ray diagnoses guarded by the qualifying phrase, "In view of the fact that this patient is known to have advanced pulmonary tuberculosis, the X-ray findings should be interpreted as indicating tuberculosis of the bowel." The writer holds the view that this is little more than a percentage diagnosis. It must be remembered that patients die of pulmonary tuberculosis with no involvement of the bowel, and furthermore, that involvement of the bowel occurs in cases with little evidence of activity in the lungs and may be the dominating condition present. I believe that the X-ray diagnosis should be made on the X-ray findings only, allowing the clinician to correlate these findings with the clinical evidence. To do otherwise is to read into the radiographic picture what one thinks ought to appear and leads to egregious error, defeating the very purpose of the X-ray examination.

Next I mention a condition of great importance, namely, stasis in the small bowel. Kornblum (5) lists the causes of small bowel stasis as follows:

- (A) Ileal stasis due to lesions in large bowel or terminal ileum.
- (B) Generalized small intestinal stasis due to—
 - (1) Extrinsic lesions producing mechanical obstruction;
 - (a) adhesions, (b) subacute and chronic peritonitis, (c) ascites;
 - (2) Intrinsic lesions involving the lumen of the small intestine;
 - (a) ulcers, (b) diverticula, (c) polyps, (d) primary neoplasms;
 - (3) Disturbance in the nervous mechanism;
 - (a) splanchnic inhibition, (b) drugs.

To this list I wish to add one more—that is, stasis due to ptosis. I wish to stress, somewhat, this last-named condition for the reason that I believe it has not been

quiring no immediate surgery, the lesion being diagnosed as a result of the motor meal examination. The balance of these cases was almost equally divided between a paralytic ileus and an acute complete mechanical obstruction. I know of no way in which one can definitely state on the basis of a flat plate alone whether the lesion is due to mechanical obstruction or ileus. I do believe that with gas present in the intestine distal to the dilated loops of small bowel, the presumption should be that of ileus and not of obstruction.

A review of these cases in view of the operative and autopsy findings brings out some interesting facts.

(1) The X-ray findings must be carefully co-ordinated with the history and physical findings.

(2) Negative X-ray findings must be ignored by the surgeon in a case with a clear-cut history and physical findings of obstruction.

(3) The location of the gas-filled coils of small bowel on the film has in a certain percentage of cases no relation to the part of the bowel obstructed. However, in most of the cases the approximate location can be quite accurately determined.

(4) Cases with gangrene of the bowel fail to give any demonstrable distention of the bowel with gas, and the "scout" roentgenograms are usually interpreted as negative.

(5) An extremely marked distention of the small bowel may occur in cases of urinary calculus.

(6) Incomplete obstruction has never yet in my series of cases given us positive findings on the "scout" plate.

(7) In very young babies the "scout" plate is of no value in determining the site of the obstruction as the small bowel becomes so enormously distended that it cannot be differentiated from the shadow of a distended colon.

DR. H. B. THOMPSON (Seattle, Wash.): I would like to tell you of one mistake I made in the diagnosis on a case which corroborates what Dr. Heacock says. This patient had been operated on for a simple appendix and

allowed to leave the hospital after one week. Immediately upon arriving home, he began to vomit. The Doctor told me about the symptoms and I made a diagnosis of obstruction before I saw the patient. He was in the hospital three or four days later and a film was made which showed a very marked enlargement of the small intestines. The enlargement, however, was so marked that it was really larger than most enlarged colons which one sees. One loop of bowel went up on the right side, corresponding to the ascending colon, straight across the upper portion of the abdomen, and down on the left side. I had made the diagnosis before I saw the patient, so I did not look at the film carefully enough to see the valvulae markings in some of these loops. They were not very distinct, but the outline of the small intestines so nearly followed the large bowel that I made a definite diagnosis of obstruction of the large bowel down in the terminal portion. At operation it was found in the small bowel. If I had paid the proper attention to the markings, I would not have made this mistake.

I wish to ask Dr. McKnight one question; that is, on the film showing the slight obstruction or delay in the second portion of the duodenum—I believe he attributed a patient's symptoms to this slight obstruction—I would like to know how he arrives at this conclusion. Is it not reasonable to assume that the patient's general condition which produced the ptosis, neurasthenia, etc., was accountable for the delay in the small bowel—that it was secondary and not really a part of the patient's symptoms?

DR. KENNETH D. A. ALLEN (Denver, Colo.): Within a year, a very capable internist came to me after I had rendered him an opinion of chronic small intestinal stenosis on his patient, and said that he had no idea the X-ray could give information about the small intestine. He has been practising medicine a good many years and has asked for many gastro-intestinal X-ray examinations and was not aware that the X-ray could demonstrate many lesions of the small intestines. Early chronic small intestinal stenosis is dif-

tary relief is obtained on the passage of gas and fluid past the constricted point. This occurs at intervals of a few moments and with a gurgling noise that can be heard at a distance of ten feet or more from the bed. On a carefully supervised soft, meat-free diet this patient is quite comfortable and is gaining weight. Operation has been avoided for the reason that active pulmonary tuberculosis is present.

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DISCUSSION¹

DR. K. S. DAVIS (Los Angeles, Calif.): The small intestine can well be termed the silent area of the gastro-intestinal tract, for if the roentgenologist has not had his attention directed particularly to this organ it is very easy to overlook lesions in which the findings are not outstanding.

In our routine gastro-intestinal examination a six-hour study is made, chiefly to note the emptying time of the stomach and to observe the motility of the barium through the small bowel. In this examination one can, in certain cases, detect variations not only in the motility of the barium but also in the size, contour, and position of the small bowel. Palpation may reveal a fixation, tenderness, palpable mass, and even at times a loss of normal flexibility of the bowel wall. Usually, however, the roentgenographic diagnosis of a lesion of

the small intestine is based on the findings of obstruction, either a hypomotility of the barium or a distention of the gut above the obstructed site, depending on the degree of involvement. The detection of a true hypermotility of the barium through a given part of the small bowel presents great difficulties, especially when one recalls the great rapidity with which the barium meal passes through this part of the intestinal tract. The normal limit for a complete evacuation of the small bowel varies from six to fifteen hours. No conclusions can be drawn from any variations from the normal unless the emptying time of the stomach has been carefully taken into consideration.

Dr. McKnight in his paper has listed many causes of stasis in the small bowel. To these I would like to add two more: (1) A slow emptying of the stomach, which probably is the most important cause of a hypomotility of the barium in the six-hour study; (2) stasis of the barium in the terminal ileum as the result of an appendicitis.

In my experience the majority of the diverticula of the small bowel have been located in the first and second portions of the duodenum. Most of these have been symptomless. It is extremely difficult to differentiate between a true diverticulum and a dilated ampulla of Vater on the basis of roentgenographic findings alone.

In the diagnosis of visceroptosis one must be extremely guarded in his opinion, as one can very easily make a life-long invalid of his patient. If the stomach empties normally and the motility of the barium through the small bowel is within the limits of normal, the relative position of the stomach in the abdomen makes but little difference in the health of the patient.

As regards the roentgenographic findings in obstruction I can do no more than reiterate what Dr. Heacock has already said. During the past five years at St. Vincent's Hospital we have had thirty-two cases of obstruction in the small bowel on which X-ray studies had been made prior to operation or autopsy. Of these cases, six were of the chronic type re-

¹The papers of Dr. Heacock (page 119) and Dr. McKnight (page 125) were discussed together.

SPECTRUM OF THE RADIATION FROM A HIGH POTENTIAL X-RAY TUBE¹

By C. C. LAURITSEN, California Institute of Technology, PASADENA, CALIFORNIA

Abstract.—A spectrograph of the Seemann type has been constructed for the purpose of investigating the radiation from the high potential X-ray tube at the California Institute. A typical spectrogram obtained with 600 kilovolts on the tube is presented. The photometer record shows a continuous spectrum with its maximum intensity at about 200

kilovolts and a short wave length limit in the neighborhood of 600 kilovolts. The range covered is roughly from 100 to 20 x-units. It is proposed to use the apparatus for determining absorption coefficients by photographing the spectrum of radiation which has passed through an absorbing screen. No anomalies of any kind have been observed so far.

APPARATUS

THE high potential X-ray tube at the California Institute of Technology has recently been rebuilt and equipped with a hot cathode and a tungsten target. A description of the tube and its housing has been presented by Lauritsen and Cassen.² The tube in its present form operates satisfactorily at 600 kilovolts and it has been deemed advisable to investigate the available radiation before attempting to go to higher potentials.

In order to investigate the region of the X-ray spectrum from approximately 150 kilovolts and up, a crystal spectrograph was constructed following the principle described by Seemann,³ Siegbahn⁴ and others. High precision cannot be expected with any reasonable time of exposure by this method since the whole of this region of the spectrum lies within an angle of less than one degree and thick slits are required because of the great penetrating power of the hard radiation. On the other hand, the method is convenient and sufficiently precise for the approximate determination of the short wave length limit as well as of the general

distribution of intensity in the spectrum. Also, if any prominent lines, bands or absorption edges or other unexpected irregularities exist in this region, they should be found most conveniently by this method.

The spectrograph consists essentially of a vertical slit 0.9 mm. wide in a lead block 4 cm. thick, in front of which a rock-salt crystal is placed. The crystal, slit, and photographic plate are all rigidly mounted on a long arm which may be rotated through an angle of one degree on each side of the center, the rotation taking place about an axis through the vertical center line of the slit. Since the focal spot has the appearance of a thin horizontal disk approximately 5 mm. in diameter, it is clear that radiation will reach the central planes of the crystal under all angles from zero to 50 minutes, provided that the distance from the focal spot to the crystal does not exceed 35 cm. and that the spectrograph arm is set at an angle of 25 minutes on either side of the center line through the focal spot and the slit. Under these conditions the undeviated part of the light will produce an image of the focal spot as seen through the slit, the whole of the image being located on one side of and adjacent to the center line of the photographic plate. The reflected portion of the light will appear as a spectrum on the other side of the center line. The short wave

¹Reprinted by permission from Physical Review, Dec. 15, 1930, XXXVI, 1680-1684.

²C. C. Lauritsen and B. Cassen, Phys. Rev., 1930, XXXVI, 988.

³Seemann, Phys. Ztschr., 1917, XVIII, 242.

⁴M. Siegbahn, Phil. Mag., 1919, II, 639.

difficult to demonstrate. A case must be studied by X-ray every hour after the motor meal in order to get evidence of early chronic stenosis, and therefore we have, all of us, overlooked early cases.

I have had two cases of chronic small intestinal stenosis within two years from a different cause than any outlined in Dr. Heacock's valuable paper. Both of them were caused by a breaking down of a lymph node which had been infected, a lymph node in the mesentery, close to the small bowel. Following the infection the lymph node area filled in with connective tissue which gradually reached out around the small intestine. Both of these cases were proven by a microscopic examination. Slowly the small intestine became stenosed. This process leads to a symptom-complex which can help us greatly in suspecting these cases. One of the cardinal symptoms of the small intestinal stenosis is repeated attacks of vomiting, distention, and pain, and if we will make an X-ray examination of one of these patients during an attack, it will be easy to show the cardinal X-ray signs. Between attacks it is

much more difficult to demonstrate a lesion. The reason for these attacks probably is that the patient commits a dietary indiscretion, the mucosa becomes inflamed and edematous, and more or less complete stenosis takes place temporarily. In these chronic cases, as Dr. Heacock has said, barium is not harmful, in fact, it finally helps to push through the edematous area.

DR. McKNIGHT (closing): I have nothing further to say except to answer as well as I can the question asked. I think probably the wording of the paper is a little misleading. What I mean to say is that when ptosis reaches a degree which, by its dragging and pulling on the more or less fixed duodenum, causes stasis in the duodenum, you do have symptoms. In other words, when you see ptosis showing persistent duodenal stasis, one may be sure that that patient is having symptoms and you will not miss it by very far if you call up that patient's physician and say, "Your patient is complaining of nervousness, abdominal discomfort, nausea, and probably more or less vomiting."

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length limit is thus given by the distance from the center line to the edge of the continuous spectrum, and lines of equal wave length are parallel to the center line. Since different wave lengths originate from differ-



Fig. 1. Double spectrum 600 K.V. peak.

ent lateral regions of the focal spot and since the intensity is not absolutely uniform throughout the whole of the area, it is not possible to obtain the intensity distribution in the spectrum directly with any degree of precision. Correction can, however, be made for this lack of uniformity if the direct beam is reduced by means of a filter to an intensity comparable to the intensity of the spectrum. This is so because the direct beam is a true image of the focal spot and the spectrum is a specular image of the direct beam, except for the wave length selectivity, and there appears to be no good reason why the radiation from different parts of the target should differ appreciably in hardness if the intensity is the same.

The photographic plate is placed 107.5 cm. from the center of the slit. In spite of this comparatively great length, the resolution is not high on account of the wide slit, but it is sufficient for the present purpose.

In order to determine the exact zero on the photographic plate it is most convenient to photograph both right and left hand spectrum on the same plate. This is done by adjusting the spectrograph as described except that the direct image is blocked out

completely by a heavy lead screen while one spectrum is being photographed. The spectrograph arm is then rotated into position on the opposite side of the center line and the direct image which now appears on the part of the plate which has been exposed is blocked off. The second exposure thus gives a spectrum on the part of the plate which was covered up during the first exposure. The result is two spectra which are symmetrical with respect to the center line or true zero. Figure 1 is a positive reproduction of a double spectrum taken in this manner.

A dark line may be seen running diagonally through the spectrum in each of the spectra of Figure 1. The origin of this line becomes apparent if we consider the geometry of the arrangement. The spectrum shown is due to reflection from vertical (100) planes of the rock-salt crystal, but if the crystal is adjusted so that the horizontal (100) planes are parallel to a horizontal plane through the focal spot and some part of the photographic plate, then it is clear that from each point of the target there will be a ray of a given wave length which will make the same angle with the horizontal as with the vertical planes. The intensity of this ray will therefore be divided between the spectrum shown and a spectrum which falls above, below, or within the direct image.

This second spectrum is of the type first obtained by Rutherford and Andrade and differs from the first in that the resolution is slightly less. The paths of a ray are shown by the lines *a*, *b*, and *c* in Figure 2, and the heavy lines *d* in the end view are the intersections with the photographic plate of all the rays which fulfill the foregoing condition. It is readily seen from the figure that the angle between the lines *d* and the vertical center line is given by

$$\tan \theta = \frac{b}{a + b}.$$

In the present case, this gives

$$\tan \theta = \frac{107.5}{142.5} = 0.755; \theta = 37.05^\circ$$

which agrees with the angles made by the dark lines in Figure 1 with the center line.

The intensity distribution was obtained by means of a recording microphotometer. In Figure 3 the galvanometer deflections obtained from the photometer records are plotted as ordinates against distance as abscissas. The tube was operated at 600 kilovolts peak and, as indicated in the graph, the short wave length limit corresponds closely to this value. The maximum intensity occurs somewhat below one-half of this potential, as might be expected, since the tube is operated with alternating current and a "thick" target is used. It should be noted, however, that the softer radiation is decreased somewhat in passing through both the 6 mm. steel wall of the tube and the crystal. The lack of symmetry which is apparent in the graph is due partly to the aforementioned non-uniformity of the focal spot and partly to a slight difference in exposure.

RESULTS

From the photograph as well as from the photometer record we may conclude that, within the limits of the resolution used, there are no unexpected irregularities in the spectrum from tungsten in the region covered. At the present time work is in progress to determine as accurately as possible how the spectrum is modified by different absorbers. The right half of Figure 4 shows the spectrum after passing through lead screens. One screen, 0.28 in. thick, covers the whole image, and in addition the central portion is covered by a second screen 0.14 in. thick. The direct beam was decreased to a suitable intensity by a steel block 2 in. thick.

The photometer records of spectra taken in this way show accurately how the spec-

trum is modified by any given absorber and it should therefore be possible to obtain from a single pair of records the absorption coefficient as a function of the wave length.

If nuclear absorption levels or other un-

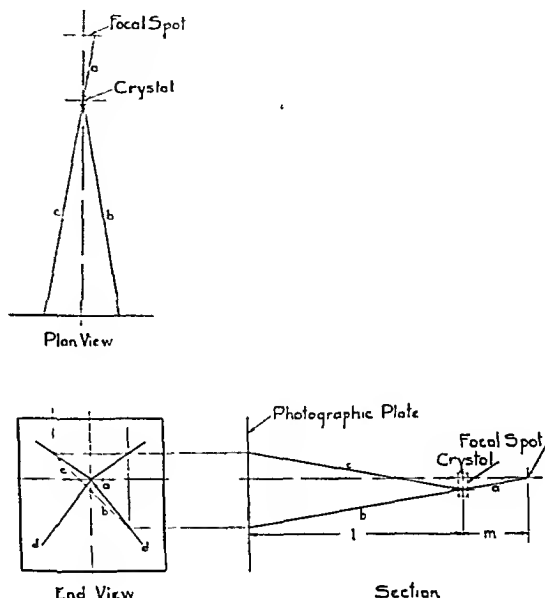


Fig. 2.

expected irregularities exist in this region of the spectrum, they should be readily detected by this method. The spectra obtained so far and also the modifications due to absorbing screens of aluminum, iron, copper, and lead are roughly what would be expected. There is no indication of any sudden changes in intensity with wave length.

REMARKS BY DR. ROBERT A. MILLIKAN¹

From the year 1921, when it first became assured that the facilities for high-potential high-power experimentation would be available at the California Institute, we have had, as a major element in our research program, the development (if possible) of a vacuum

¹Before the Radiological Society of North America, at a meeting held in the Norman Bridge Laboratory of Physics, California Institute of Technology, Pasadena, Dec. 3, 1930.

tube which would stand, without breakdown, something like the potentials developed by our million-volt installation. Indeed, one of the chief reasons for my own coming from the University of Chicago to the California Institute was the opportunity

pulled out of the electrodes by the enormous fields set up at the surfaces or else was induced by the impact against the electrodes of electrons originally pulled out by such fields. The study of the conditions under which currents may be pulled out of cold

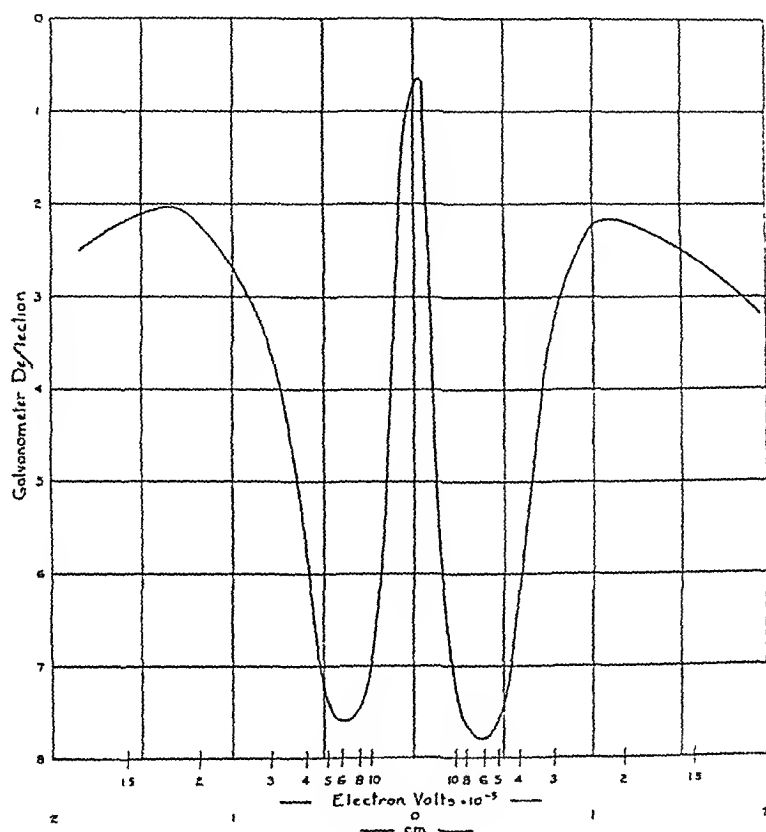


Fig. 3.

afforded by the Institute for assisting in this type of development.

After at least three unsuccessful attempts made between 1922 and 1927, the problem was successfully solved by Dr. C. C. Lauritsen in 1928 to this extent. In that year a large one-chamber vacuum tube, with electrodes but a few centimeters apart, was built by him, which did not puncture or break down in any way when potentials up to 750,000 volts were applied to it. The only current that passed through this tube was

electrodes by such intense fields has been one of the major activities of our Laboratory since its completion in 1921, and Dr. Lauritsen has been one of the most productive workers in that field. Last Spring he modified his so-called cold emission 750,000-volt tube by putting a hot filament in one of its electrodes. This has two effects: first, it tends to lower somewhat the potential reached, but, second, it renders the flow of energy more uniform and more controllable. The net result is that now a cathode-ray

beam five milliamperes strong and driven by a potential up to 650,000 volts bombards the anticathode and there generates highly penetrating X-rays both of a frequency or penetrating power and of an intensity much higher than have been obtainable thus far. The wave lengths are not far below those of the gamma rays from radium.

There are three types of investigations that are thus opened up by Dr. Lauritsen's accomplishment: first, scientific studies of the properties of these very powerful and very penetrating rays themselves; second, physical studies of the transparencies of metals and other opaque substances with largely increased possibilities for the detection of inhomogeneities or inclusions of one sort or another in large masses of dense materials; third, biological studies of the effects of these rays on living organisms. Dr. Lauritsen proposes to work out all these possibilities, but no conclusions will be drawn before we have enough data to have confidence in the experimental results and in the generalizations that may be drawn from them. In the biological field we ourselves have practically no knowledge at all

as yet about the effects of these rays and we probably shall not have for a period of several years. In other words, for a considerable period we shall in all probability have nothing whatever to report beyond what we



Fig. 4. Left, direct image; right, spectrum.

are reporting now. Premature conclusions would be both unscientific and dangerous. An agency of this sort should and will be given long trial before any conclusions can be drawn that have any interest whatever to the general public. When we have learned anything about these rays that is dependable we shall of course publish it and otherwise give it to the public, but not before.

QUANTITATIVE MEASUREMENT OF DIATHERMY DOSAGE

By A. HEMINGWAY, MINNEAPOLIS, MINNESOTA
From the Department of Physiology, University of Minnesota

Abstract.—Evidence is presented which shows that a thermocouple voltmeter together with a thermocouple ammeter would be suitable to measure diathermy heat dosage, since across the tissue the high frequency current and voltage are in phase. Experiments are

reported on the heat production by diathermy currents in tissue which show that the heat imparted to the tissue can be computed from the effective high frequency voltage drop across the tissue and the diathermy current.

IT IS the opinion of the majority of clinicians that the sole benefit of diathermy is the production of heat in the tissues. Hitherto, there has been no method of determining the amount of heat energy which a patient has received from a treatment. Dosage has been regulated by the current which traverses the tissues, the current having a value sufficiently low so that burning of the skin at the electrodes does not occur. A knowledge of the value of the electrical current, however, is not sufficient to determine the amount of heat energy which is imparted to the patient.

To measure the heat produced in the patient by diathermy, the true diathermy current must be known and either the true high frequency electrical resistance or the effective high frequency voltage. In the case of the latter it must also be stipulated that the voltage and current are in phase.

In order to measure the electrical resistance of tissues at the alternating current frequency of the diathermy current, much elaborate apparatus and careful technic are required. It has been shown by Gildemeister (1) that the observed electrical resistance of the human body decreases with increasing frequency, and Philippon (2) has shown that to high frequency currents of one million cycles per second and greater, the impedance for increasing frequency remains constant. This constant value is interpreted as the true electrical resistance of

the tissue and such an interpretation is supported by the calorimetric measurements in this paper. However, the measurement of the electrical resistance at high frequency, which would give the heat produced when computed by Joule's (current)² \times resistance relation, is not practical clinically. Apparatus to measure high frequency resistance is described by McClendon (3), Stratton (4), Fricke (5), Ferguson (6) and others, but a glance at their papers will assure one that such apparatus is too bulky and complex to be used for resistance measurement in a diathermy treatment.

In the use of a voltmeter to measure the diathermy heat dosage, there are several requirements. The heat produced is given by the expression, "current \times voltage \times cosine of phase angle." Only if the cosine of the phase angle is equal to unity may the heat energy be computed from the product of current and voltage. However, the fact that at high frequencies the impedance becomes constant with increasing frequency would satisfy the demand that the cosine of the phase angle is unity. This is true only with widely separated electrodes, as in diathermy, and only with alternating current of the present diathermy frequencies. A further requirement is that the voltmeter record the effective or root mean square voltage and not the peak voltage as measured by vacuum tube voltmeters. Also it is well known that the electrodynamicometer volt-

meters used with low frequencies of sixty cycles per second cannot be used, due to their high inductance and distributed capacity.

An instrument which would fulfill these

our purpose by one of the leading manufacturers of electrical instruments.

It is obvious that one cannot use a patient for quantitative calorimetric measurements in diathermy. A suitable equivalent has

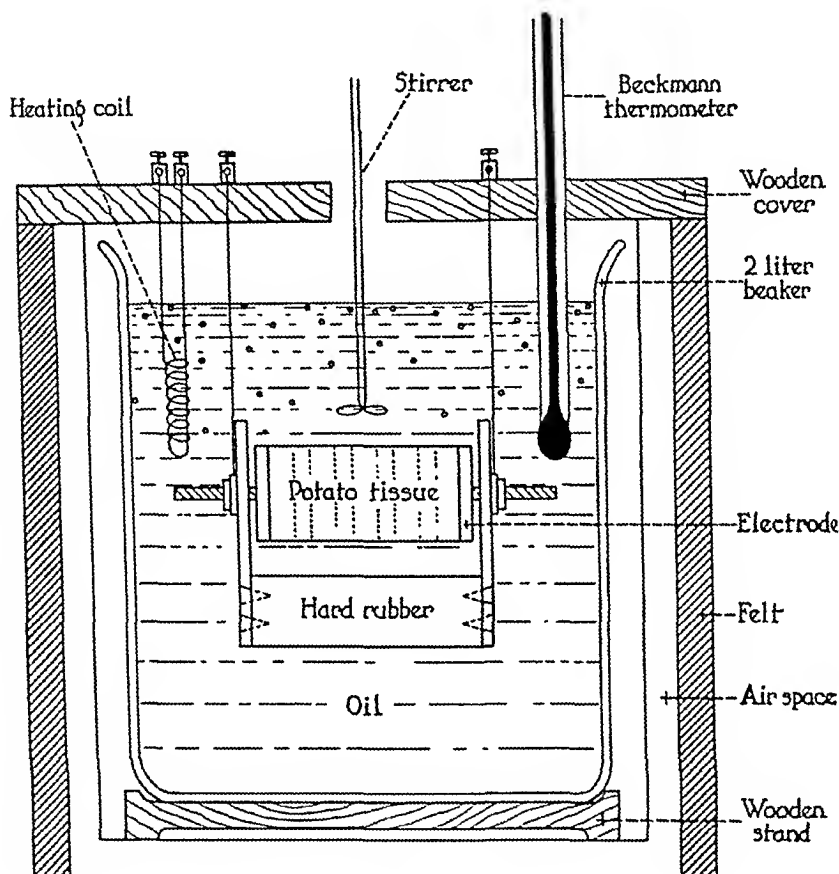


Fig. 1.

requirements is the recently developed thermocouple voltmeter. This instrument is operated on the same principle as the thermocouple ammeter ordinarily used in diathermy, wherein the small voltmeter current, in traversing a thin resistance heating wire, heats a thermocouple junction which in turn is connected with a sensitive d.c. galvanometer. Such a voltmeter is described by Wilson (7). Voltmeters which would register sufficiently high voltage are not usually made, but one was constructed especially for

been found in another way. A section of a potato was placed between electrodes and immersed in a light lubricating oil. The heat generated in the potato tissue due to diathermy current was imparted to the non-conducting oil which was rapidly circulated about the tissue. The potato was perforated to allow circulation of oil through it and sections were chosen whose high frequency electrical resistances were of the order of magnitude of those of a patient in a diathermy treatment. Such a scheme is a suit-

able electrical representation of the body tissues, since the cells, due to their membranes, have a high resistance to low frequency alternating current and a low resistance to high frequency A.C. in the same

capacity of the oil, tissue, and coil was accordingly

$$\frac{\text{Volts} \times \text{amperes} \times \Delta t_1}{4.19 \times \Delta T_1} \text{ calories per degree C. (1)}$$

Potato sections of different sizes were

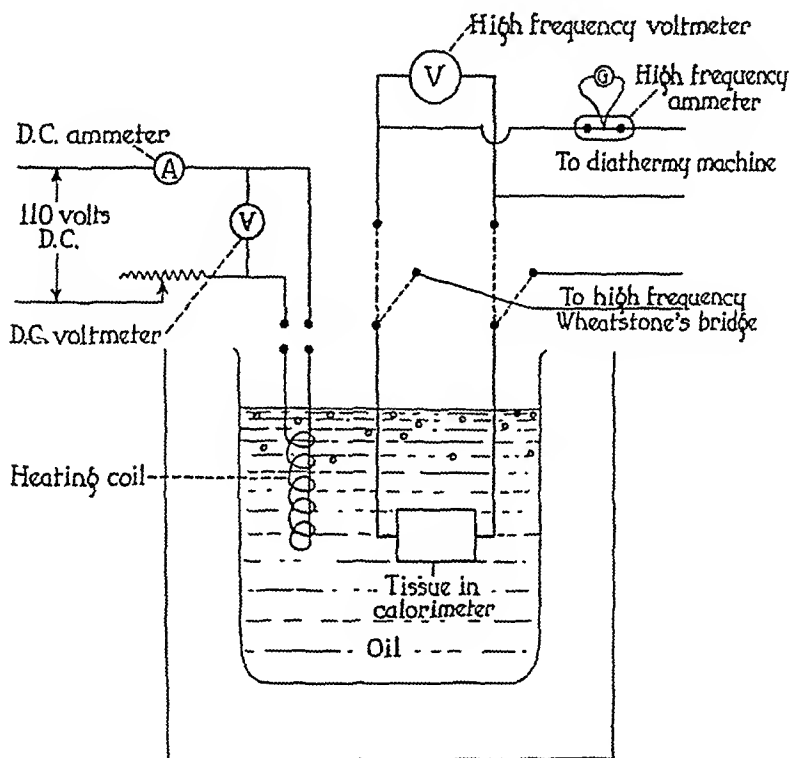


Fig. 2.

manner as animal tissues. A diagram of the calorimetric arrangement is shown in Figure 1.

To measure the heat capacity of the system a small heating coil of 20-ohms resistance was used with direct current and immersed in the oil, together with the tissue. The voltage drop across the coil when a current of two amperes passed through it was measured as well as the temperature increase (ΔT_1) of the oil and the duration time (Δt_1) of the current. The temperature was measured by the Beckmann thermometer shown in Figure 1. The heat ca-

used to give different high frequency resistances, the resistances having values of those of a patient to a diathermy current. As shown in an earlier paper (8), these resistances extend from 20 to 150 ohms. Resistances were measured by the high frequency conductivity bridge as used by McClendon (3) and Remington (9). A general scheme of the circuits used is given in Figure 2.

The diathermy current was measured by a calibrated vacuum thermocouple ammeter, while the voltage was measured by the thermocouple voltmeter already described. The temperature increase of the oil, warmed by

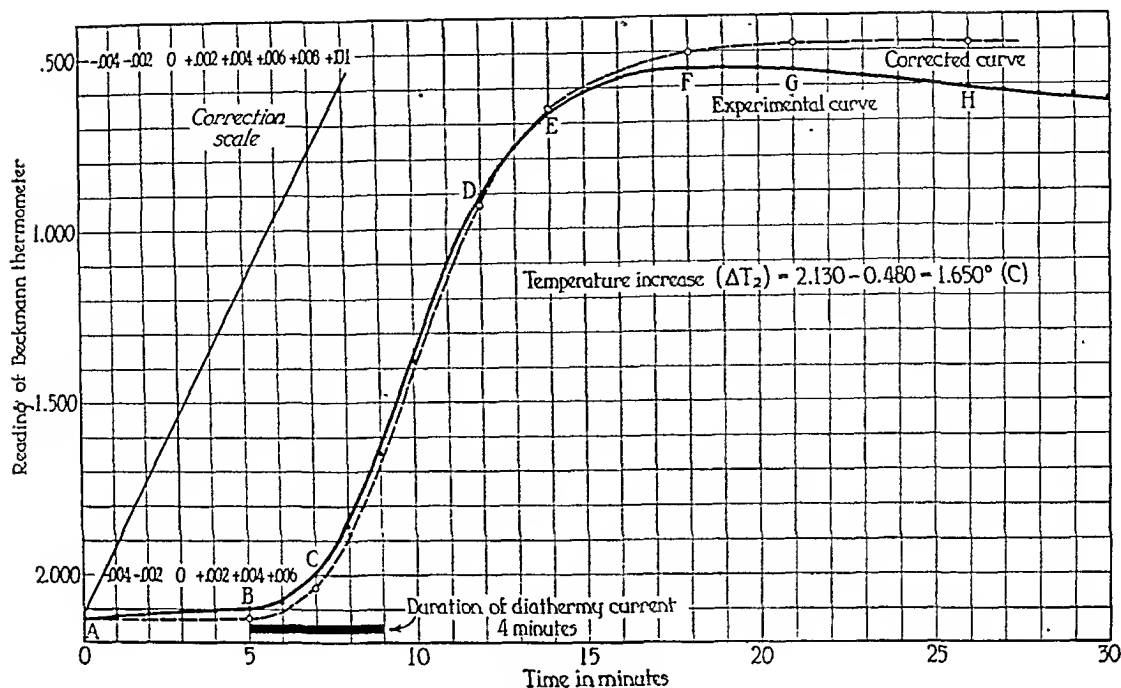


Fig. 3.

heat conduction from the tissue, was measured by the Beckmann thermometer as shown in Figure 1.

In measuring the temperature increase (ΔT_2) of the system, either by the heating coil with d.c. to measure the heat capacity, or by the diathermy current traversing the potato tissue, corrections for two sources of error must be made. These corrections are for (1) heat loss due to radiation where the temperature of the oil is above or below the surroundings, and (2) a slight heat production due to the motion of the stirrer in the viscous oil. Both of these corrections are small, since the temperature difference between oil and surroundings never exceeded 2 degrees C., but, since ΔT_2 had values from 1 to 2 degrees C. and was measured to an accuracy of 0.001 degree C., they were appreciable. Corrections for both of these errors were made simultaneously from a study of the temperature changes before and after the passage of the current. A corrected curve, taking these errors into consideration, was drawn accord-

ing to the method given by Duncan and Starling (10) and is shown in Figure 3.

Knowing the corrected temperature increase ΔT_2 due to passage of the diathermy current and the heat capacity of the system computed from heating the coil with d.c., the rate of production of heat energy

measured as $\frac{\Delta H}{\Delta t_2}$ was computed in watts by the formula

$$\frac{\Delta H}{\Delta t} = \frac{\text{Heat capacity} \times \Delta T}{\Delta t} \text{ watts} \quad (2)$$

The computed energy increase in watts was determined by the product of the diathermy voltage E and the diathermy current I according to

$$\text{Computed heat energy} = E \times I \text{ watts} \quad (3)$$

Since the phase angle is zero (*i.e.*, cosine of phase angle = 1), then the high frequency resistance of the tissue can be computed from the formula

$$\text{Resistance } R = \frac{E}{I} \quad (4)$$

RESULTS

The results of the experiments are con-

tained in Table I, where the symbols have the following meanings:

Column I.—H is the heat capacity of the oil, tissue, and coil system. It is computed according to Equation (1) and given in calories per degree.

Column II.—E is the reading of the high frequency thermocouple voltmeter, giving the effective voltage drop across the tissue due to the diathermy current.

Column III.—I records the diathermy current, as measured by a calibrated vacuum thermocouple ammeter, and from a diathermy machine operating at a frequency of approximately 500 kilocycles.

Column IV.— $\frac{\Delta H}{\Delta t_2}$ is the observed rate at which heat is imparted to the system and is given in watts.

Column V is the computed rate of heat production as determined from a reading of the high frequency voltmeter and ammeter (see Equation 3).

Column VI contains the value of the high frequency resistance as measured by a high frequency Wheatstone bridge at a frequency of one million cycles per second. The method of balancing the tissue in the cell was to use a resistance in series with a capacity.

Column VII gives the resistance computed according to Equation (4) from the observed diathermy voltage and current of Columns II and III.

It will be noticed that for sections with the higher resistances, the resistance as measured by the high frequency conductivity bridge is higher than the resistance computed from the diathermy voltage and current. For these smaller sections of tissue it was noticed that, as the heating progressed, the voltage would decrease and the current increase, giving, therefore, a lower resistance due to the heating of the tissue. The heat was not immediately imparted to the oil, as the temperature-time curves indicate. Average values of the current and voltage

TABLE I

I	II	III	IV	V	VI	VII
H Cals. per degree C.	E Volts	I Amperes	$\Delta H / \Delta t_2$ Watts	EI Watts	R Ohms	R Ohms
846	30	0.765	24.3	22.9	39	39.2
846	27.5	0.732	19.7	20.1	39	37.5
725	49.5	0.784	38.2	38.8	65	63.1
725	44.0	0.633	26.3	27.8	65	69.5
798	52.0	0.650	30.0	33.8	100	74.5
798	43.0	0.565	26.6	24.2	100	76.2
810	48.0	0.312	15.0	15.0	125-200	154

for a run were taken. For the larger sections of tissue with the larger tissue heat capacities in which the rise in temperature due to the diathermy current was not very great the two resistance values agree. In the resistance values of the lower row, in Column VI, two values are given. In one case the cold tissue resistance was measured (200 ohms) and in the other the resistance (125 ohms) was measured as soon as the diathermy current was discontinued after a usual run. The purpose in measuring high frequency resistances was merely to have tissue resistances of the order of magnitude of diathermy resistances; therefore, temperature fluctuations and consequently resistance fluctuations, if within the range of diathermy resistances, do not interfere with the technic of the experiment.

These experiments have been repeated using electrolytic solutions. Similar results have been obtained.

CONCLUSIONS

From Columns IV and V of Table I it follows that the heat dosage of diathermy may be computed from the diathermy current and the effective voltage drop across the tissue. The heat energy imparted to a patient in a diathermy treatment in calories may then be calculated from the formula

Heat energy = $0.24 EI t$ calories
where E is the voltage drop, I the diathermy current, and t the time of duration of the treatment. This eliminates the necessity of measuring the high frequency resistance and

computing the heat energy from the formula

$$\text{Heat energy} = 0.24 I^2 R t.$$

The voltmeter method of measuring diathermy dosage is very practical clinically since the only way that the usual diathermy machine has to be modified is to insert a portable thermocouple voltmeter in parallel with the patient.

In conclusion, I wish to express my appreciation to Dr. W. K. Stenstrom, of the Department of Biophysics, for his interest in this problem and for useful suggestions. I am also very grateful to the Victor X-ray Company for the loan of the diathermy machine which was used in the experiments.

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PULMONARY TUBERCULOSIS IN INFANTS AND CHILDREN¹

By CARL E. KOENIG, M.D., SEATTLE, WASHINGTON

WHEN roentgenology began to be employed as an aid in the diagnosis of pulmonary tuberculosis the significance of the findings was at first not correctly evaluated. Apparently it was thought that this new method of examination should stand on its own merits and arrive at conclusions in a definite manner similar to that characteristic of it in the diagnosis of fractured bones. Regarding the matter of fractures the evidence was, almost without exception, either positive or negative; while in pulmonary tuberculosis the X-ray findings were in themselves very frequently neither positive, nor negative. The assistance of other diagnostic aids was required, and, because a diagnosis was not made independently of these other factors, the value of X-ray evidence was sometimes under-rated.

We know that the relative values of different diagnostic methods are extremely variable. A single factor such as a sputum examination may be highly significant, and, again, it may have no value whatsoever. This is true, in a general sense, of all methods used in diagnosing pulmonary conditions, but it is no more true of X-ray examination than it is of physical examination.

In a physical examination of pulmonary conditions the discovery of numerous moist râles in a subapical region is very suggestive if they are persistent; but the stethoscopic findings, along with all of the other physical findings, are not conclusive. A physical examination must be supported by many or all diagnostic aids before a diagnosis is made, but we do not under-value the importance of physical examination because we find that it is not self-sufficient.

There is an X-ray finding in pulmonary tuberculosis which is comparable in value to the discovery of moist râles. I refer to the persistent presence of parenchymal X-ray lesions in a subapical region. So significant are they that they have been included in the Trudeau Sanatorium "Five Diagnostic Criteria of Pulmonary Tuberculosis" (1). The persistent clinical finding of moist râles in a subapical region also belongs to this list.

Physical or X-ray examinations, in common with other diagnostic aids such as clinical history, laboratory analyses, and skin tests, are rarely sufficient in themselves, but all have value—variable in importance in different cases—in helping to establish a diagnosis.

With this background may we take into consideration the subject of pulmonary tuberculosis as it occurs in infants and children? Here, again, conclusions must be arrived at by deductive reasoning, using all the means at hand, as there are rarely any pathognomonic findings.

Considerable attention is to be given to differential diagnosis, but it is so intimately linked with classification of pulmonary tissue changes that it will be necessary, first, to discuss the different types of lesions.

McPhedran has formulated an excellent outline relative to types of lesions occurring in pulmonary tuberculosis in children (2). They are classified as follows:

Parenchymal lesions:

- (A) Focal tuberculosis—caseous or calcified.
- (B) Tuberculous consolidation—progressive or unstable.
- (C) Tuberculous consolidation—retrogressive or benign.
- (D) Diffuse childhood type tuberculous infiltration.

¹Read before the Radiological Society of North America at the Annual Meeting in Los Angeles, California, Dec. 1-5, 1930.

(E) Miliary tuberculosis.

Tracheobronchial lesions:

(A) Tuberculosis of tracheobronchial lymph nodes, uncalcified.

(B) Tuberculosis of tracheobronchial lymph nodes, calcified.

Lesions of adolescence:

(A) Apical adult type infiltration of children and adolescents.

will hasten on to the discussion of other parenchymal lesions.

Tuberculous consolidation which is progressive or unstable is revealed as a shadow of increased density, conforming in outline to a lobe of a lung or as a roughly wedge-shaped mass. These increase or fluctuate in extent or they excavate.

Tuberculous consolidation, retrogressive and



Fig. 1



Fig. 2

Fig. 1. Lobar pneumonia, non-tuberculous.

How long sick?—Sick for only a day or two before entering hospital. Recovery in a week or ten days.

How sick?—Onset abrupt. Patient acutely ill, vomiting, convulsive, lethargic, and with high temperature.

Temperature?—High, constant, 103.5 degrees. Dropped by lysis.

Contact?—No history.

D. S., female; age, 4 years (Children's Orthopedic Hospital, Seattle).

Fig. 2. Tuberculous consolidation, progressive.

How long sick?—History of several months' illness.

How sick?—Ambulatory. Came to Out-patient Department of hospital, complaining of cough, loss in weight, anorexia.

Temperature?—Intermittent; P. M.—0.1 to 1.15 degree above normal.

Contact?—No history of exposure. Positive Mantoux.

C. G., male; age, 14 years (Children's Orthopedic Hospital, Seattle).

Still has large parenchymal lesion, subapical lesion, unchanged two months after first X-ray examination.

McPhedran describes the first-mentioned parenchymal lesion—focal tuberculosis—as “an isolated sharply defined subpleural density” and adds that “it is often obscured by denser structures.” When seen, it is a characteristic sign of the existence or previous existence of pulmonary tuberculosis. Because of its characteristic qualities differential diagnosis gives us little concern, so we

benign, is described as a homogeneous wedge-shaped shadow most dense anteriorly when viewed obliquely. Its maximum density and extent is found at the onset. It clears slowly, starting at the axilla.

Diffuse childhood type tuberculous infiltration occurs as spots, strands or both, denser toward the pleura in tangential views. Indolent lesions are strand-like and recur unilaterally. Progressive lesions show confluent spots



Fig. 3. Tuberculous consolidation, progressive, excavating. (Children's Orthopedic Hospital, Seattle).

which may develop into tuberculous consolidation, progressive and unstable (4).

From these descriptions it will be quite readily seen that both types of tuberculous consolidation resemble lobar pneumonia in X-ray appearance, and diffuse childhood type tuberculous infiltration resembles bronchopneumonia. To facilitate description and make comparisons readily let us place these three types of parenchymal lesions in one group under the old classification of tuberculous pneumonia.

We should not minimize the value of classification according to tissue changes, that is, whether they are parenchymal, glandular, or otherwise, but the question which is most fundamental and most important of all whenever we discover pulmonary lesions is this: Are they tuberculous or non-tuberculous? This point cannot be overemphasized. There are no typical X-ray features differentiating tuberculous from non-tuberculous pneumonia. The X-ray findings in both conditions are the same, and other diagnostic aids must be used in making a differential diagnosis. In this, clinical history frequently takes a major part. We are at times con-

fronted with X-ray plates demonstrating shadows which may be tuberculous or non-tuberculous pneumonia. In making a differential diagnosis let these simple, important questions be asked:

1. How long has the patient been sick?
2. How sick is he?
3. If he has fever, what is the type of the fever?
4. Has he been in intimate contact with an adult person ill with tuberculosis?
5. Is the Mantoux test positive?

Keeping in mind the first two questions relative to the length of illness and its severity, we are guided in making conclusions by these facts: In non-tuberculous pneumonia the onset is abrupt, the patient is acutely ill, and the duration of the illness is short. In tuberculous pneumonia the onset is usually gradual, with certain exceptions the patient is not acutely ill, and the illness persists over a considerable length of time, and, let us add, the X-ray lesions are persistent.

When tuberculous pneumonia occurs in children under two years of age or, in fact, in older children in which tuberculous pneumonia is the result of a primary infection, the clinical differentiation is not so definite. No immunity to the disease has been acquired and the symptoms are acute.

Let us now consider the third question. The type of fever, whether it be slightly elevated and intermittent as occurs in tuberculous pneumonia, or high and constant as is found in non-tuberculous pneumonia, gives information of decided diagnostic value.

Relative to the fourth question there is this to be said. A history of exposure to infection is valuable. If an adult member of the family or an intimate friend of the family is ill of tuberculosis, the children of that family sooner or later become infected and active pulmonary disease is found in a large number living in such an environment.

Such a history may furnish information leading to a differential diagnosis.

A word must be said regarding the Mantoux skin test. Authorities are agreed that a positive test is, in the early years of life, suggestive or conclusive of the existence of

nosis can be made from them alone. For this reason differential diagnosis is not being considered.

Again quoting from McPhedran's outline:

The X-ray appearance of uncalcified



Fig. 4-A

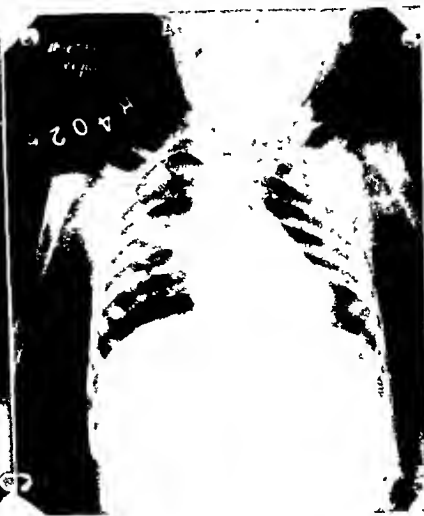


Fig. 4-B

Figs. 4-A and 4-B. Tracheobronchial lesions, uncalcified.

How long sick?—Confined in hospital five months. Sick several months before entry.

How sick?—Not acutely ill.

Temperature?—Intermittent fever, rarely above 100 degrees, but frequently that high in afternoon.

Contact?—Father died of tuberculosis. Positive Mantoux. First, X-ray findings of enlarged tracheobronchial glands; later, parenchymal lesion. Primary focal lesion not found. Patient has been troubled with phlyctenular conjunctivitis, a complication of tuberculosis.

L. S. male; age, 2 years (Children's Orthopedic Hospital, Seattle).

tuberculosis. After two years of age a positive reaction is not so valuable, but a negative test definitely excludes the existence of tuberculosis and we who interpret roentgenograms should recognize that if pulmonary lesions are seen they should be classified as non-tuberculous or healed tuberculous lesions when the skin test is negative. Miliary tuberculosis offers an exception, as the Mantoux test is sometimes negative in this serious form of tuberculosis.

The lesions of miliary tuberculosis are also parenchymatous in type. They occur as "universally distributed soft mottled shadows in both lungs," and the X-ray findings are so characteristic that a direct diag-

nosis can be made from them alone. For this reason differential diagnosis is not being considered.

Uncalcified lesions, on the other hand, are not dismissed so easily. There are many etiological factors other than tuberculosis causing enlargement of tracheobronchial glands and a clinical history and other diagnostic aids must be resorted to in making

tracheobronchial lymph nodes is depicted upon radiograms as large convex masses projecting into the parenchyma from the mediastinum or hilus, or from both. . . . Calcified tracheobronchial lesions are demonstrated as granular, stippled, or irregular dense shadows.



Fig. 5. Tracheobronchial lesions, calcified. (Children's Orthopedic Hospital, Seattle).

a differential diagnosis. History of recent existence of some acute infectious disease, post-nasal infection or other respiratory or mediastinal diseases must be considered. X-ray findings of glandular enlargement do not have any distinguishing roentgen features, and it is only when they are seen to be caseous or calcareous that they can be definitely classified as tuberculous from an X-ray standpoint alone.

We will now consider lesions of adolescence. These are described by McPhehdan as "spots, or spots and strands, or wedges, or irregular masses based on apical pleura often most easily demonstrable below the third or fourth rib posteriorly." (In other words, in a subapical region.)

Differential diagnosis in pulmonary tuberculosis of the adolescent is practically identical with tuberculosis of the adult and should be approached in the same manner. Answers should be gotten to the clinical questions which are stressed in this paper and every diagnostic aid should be employed.

Myers, of the University of Minnesota, gives an excellent description of this type of pulmonary tuberculosis in his recent pub-

lication "Tuberculosis among Children" (3). I quote briefly:

About the time the twelfth year of life is past, the tuberculosis scene changes. In the background one sees the childhood type of tuberculosis, sometimes in calcified form (calcified tracheobronchial glands or calcified focal tuberculosis); again in the form of recent inflammatory processes in the lung parenchyma (parenchymal lesions). Any boy or girl who has not been previously infected so as to develop pulmonary disease will suffer from the childhood type as would an infant of six months. The adult type is the destructive type that takes such a toll in human life through the teen ages. It never develops except in the presence of previous infection with tubercle bacilli which has resulted in some immunity. The disease usually begins in the region of the apex of one or both lungs. There is a strong tendency toward fibrosis, since the disease is of a chronic nature. The regional lymph nodes do not show the same changes as they do in the childhood type of tuberculosis. There may be some enlargement at the lung hilus but at the postmortem table caseous and calcified nodes usually are not seen unless they are remnants of the old childhood type and are quite independent of the new adult type of tuberculosis.

And here he makes a significant statement.

Recent X-ray studies have shown that such lesions (that is, lesions of adolescence) often are present months, and even years, before they result in symptoms of tuberculosis. Even the physical examination may be entirely negative while the lesions are undergoing development. Disease of quite advanced stage is not uncommon in a girl or boy in the teen ages who appears normal, perhaps is overweight, or even one who is engaged in major athletic activities.

Are not these statements of Myers interesting and instructive? They indicate how insidious and treacherous pulmonary tuberculosis may be when it occurs in the adolescent child. They warn us of the neces-

sity of making X-ray examinations of the chest when there are persistent or recurring symptoms, even though they may be slight.

SUMMARY

Physical and X-ray examinations of chest diseases are rarely sufficient in themselves. Other diagnostic aids must be used in making a differential diagnosis.

When lesions are seen in an X-ray examination of the chest it is very important to determine whether these lesions be tuberculous or non-tuberculous.

In differentiating between tuberculous and non-tuberculous pulmonary disease, the following questions are important: (1) How long has the patient been sick? (2) How sick is he? (3) What is the type of fever? (4) Has the patient come in contact with

tuberculosis? (5) Is the Mantoux test positive?

McPhedran's classification of tuberculous pulmonary lesions in children is very valuable.

In discussing parenchymal lesions of adolescence, Myers is quoted as saying: "Recent X-ray studies have shown that such lesions often are present months and even years before they result in symptoms of tuberculosis."

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Fig. 5. Tracheobronchial lesions, calcified. (Children's Orthopedic Hospital, Seattle).

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Are not these statements of Myers interesting and instructive? They indicate how insidious and treacherous pulmonary tuberculosis may be when it occurs in the adolescent child. They warn us of the neces-

nected. The base rests on ball-bearing castors for easy rolling.

The cross-arm is long enough to extend

the fork on its center of gravity on two side prongs of the fork holder. This entire arrangement makes for complete universal

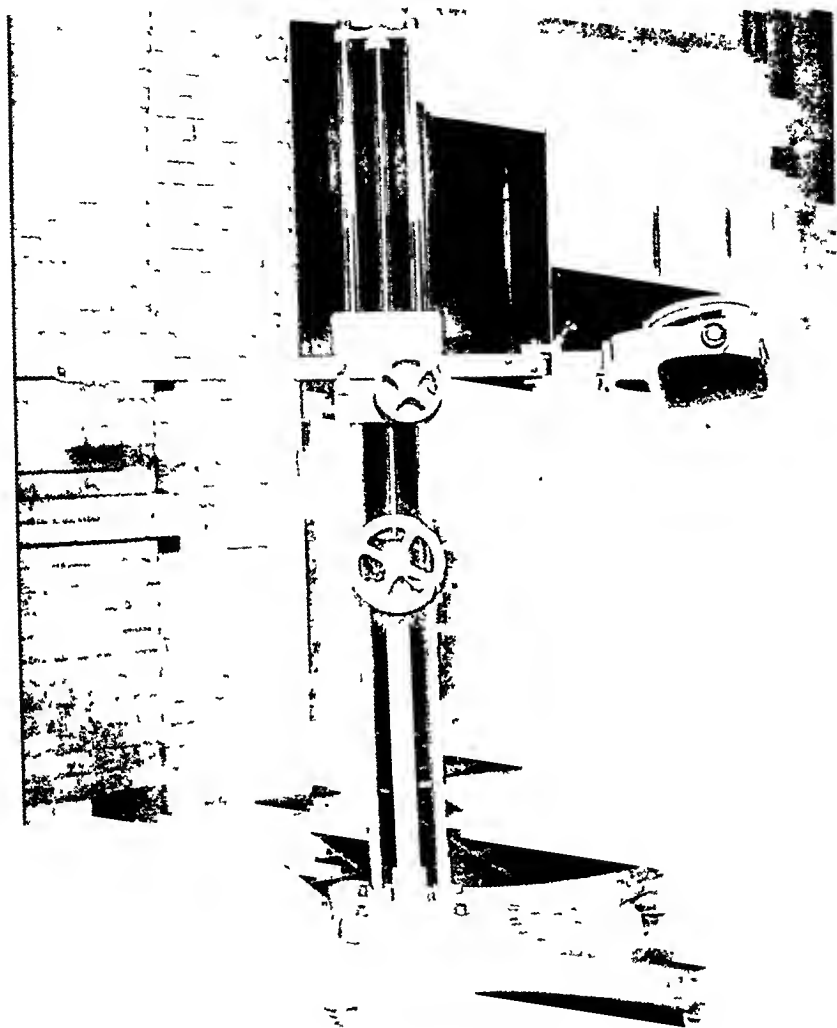


Fig 1 A practical radium pack for bedside use.

83 centimeters (32 inches) over a bed, and at its end, attached by a hinged joint, is a steel fork which supports the radium shield. The prongs of the fork are welded together into a swivel-locked socket joint attached to the stem, which is hinged to the cross-arm. The radium container is suspended in

movement such as is necessary in the adjustment of the radium applicator to the surface requiring treatment.

The radium container is a cylindrical box of lead weighing 120 pounds, encased in a copper jacket, one millimeter thick, over which is a laminated, turned wooden shell

CASE REPORTS AND NEW DEVICES

A PRACTICAL RADIUM PACK FOR BEDSIDE USE

By IRA I. KAPLAN, B.S., M.D., Director, Division of Cancer, Department of Hospitals, New York City; Attending Radiation Therapist, Bellevue Hospital; Professor Clinical Surgery, New York University and Bellevue Medical College, New York City

In the large general hospital where cancer cases of every type and in all stages of the disease are admitted to the radiation service, it is essential that there be some flexible method of administering the radiation to those patients who must receive treatments while confined in a hospital bed. In such cases, in which the local lesion to be treated is small and in which intratumoral or small surface applicators can be employed, there is, of course, very little difficulty in carrying out the prescribed therapy. However, in those cases in which massive doses of radiation have to be given, then, either the high voltage X-rays or the large radium pack must be used. Obviously it is impossible for physical reasons to move a high voltage X-ray apparatus to a patient's bedside. Similarly, the ordinary radium pack, as constructed in the various clinics here and abroad, is a stationary contrivance installed in a special room to which the patient must be transported.

As is well known, the cancer patient is usually apprehensive of the treatment given him and fearful of being confined in a room alone with the mysterious radiation forces he has been advised to allow to have administered. He dreads the idea of leaving those around him, and in one sense he exemplifies the truth of the old adage that "misery loves company."

It seemed to us, therefore, quite worth-

while and feasible to construct an apparatus which we could transport to the patient and which would permit of the application of a large amount of radium radiation to him, or to the lesion requiring it, while he was in his bed among his fellow-patients. This would enable him to carry on his normal mental existence; eat, drink, and sleep in an unfrightened atmosphere under the supervision of the regular ward nurses and physicians.

From the therapist's standpoint it was necessary to have this portable radiation apparatus so made as to be flexible and easily adaptable to all positions and all locations of lesions, be readily movable, and adjustable to the hospital bed. This portable pack must also be large enough to carry a gram or more of radium in such manner as to allow for the emission of a maximum amount of gamma radiation in a desired direction to the part to be treated, while at the same time protecting both the patient and his attendant as well as neighboring patients from scattered radiation.

In designing any portable radium pack, several problems had to be considered: (1) The radiant source must be encased in a well-protected lead box. On account of the large amount of lead used in its manufacture, this lead-shielded radium container is very heavy, and, therefore, any stand made to carry it must necessarily be heavy enough to prevent tilting. (2) In order to reach over a patient in bed there is needed a long extension arm on which the radium container can be hung.

To meet these requirements, a large, heavy, iron base was constructed, capable of withstanding a tilting strain of 3,000 pounds. To this base are attached three tubular up-rights on which the mechanism for raising, lowering, and moving the cross-arm is con-



Fig 1. Film made six hours after the ingestion of food



Fig. 2 Film made twenty-four hours after the ingestion of food: normal position.

the age of 25 years he was thrown off a cliff forty feet high, and then slid eight feet, striking against a rock.

The unusual mobility of the colon is probably not related to the colitis and was a coincidental finding.

TWO CASES OF CARCINOMA OF THE EPICARDIA

By A R BLOOM, M.D., DETROIT, MICHIGAN

Carcinoma of the epicardia (sub-diaphragmatic portion of the esophagus) is not rare, but the following two cases are reported because each presents an interesting feature from the roentgenologic and pathologic aspects

Case 1 Mr S. R., aged 50, was referred to me by Dr P. H. Brondo on May 22, 1929, for gastro-intestinal roentgen-ray study. The patient complained that since January, 1929, he had been experiencing a sensation of pressure of the epigastrium after meals, together with burning and ach-

ing at this point. He also stated that he had pain at the angle of the scapula, pain in the lower spine, pain in the rectum, and burning on urination. He had lost some weight, was constipated, and coughed. He had worked until six weeks prior to this examination. The past history disclosed that he had had malaria several years before. The family history was of no importance.

Physical examination revealed a well nourished, well built male, presenting no evidence of acute illness or cachexia. The heart and lungs were normal. There was tenderness over the cecum, hepatic flexure, and sigmoid. The spleen and kidney were not palpable. The prostate was large and

22 millimeters thick snugly fitted over the copper. The lead box is lined with a one-millimeter layer of copper. The lead shield is 32 millimeters thick and the overall diameter of the lead is 19 centimeters. The inside diameter of the cylindrical cavity of the box is $12\frac{1}{2}$ centimeters. The height of the cylinder is 25 centimeters. The top is made of a wood-covered leaden lid hinged to one side and with a hasp on the other for locking with a padlock. The base of the box has a diaphragm opening 10 centimeters square, and is thus constructed so that various sizes of lead blocks with wood cones of different sized diaphragms may be attached to the outside to vary, as desired, the distance from the radiant energy source. Space is left between the base and the cones for

the various types of filters it may be desirable to use.

The cross-arm moves up and down by means of a long screw driven by an iron gear arrangement, which is mounted on Timken roller bearings, while the horizontal movement of the cross-arm is effected by means of a rack and pinion gear. Ball bearings reduce friction to a minimum. The various arrangements of gears allow for precision settings of the cross-arm.

Complete, the whole stand weighs about 550 pounds, but, because of the roller-bearing castors, can be easily pushed about the ward. With the assistance of Mr. Stoyer, of the Peerless Electro-medical Corporation, the portable pack herewith illustrated (Fig. 1) was constructed.

MIGRATING COLON¹

CASE REPORT

By C. E. PIERSALL, M.D., F.A.C.R.,
RENO, NEVADA

On October 18, 1930, C. W. W., a male physician, aged 53 years, weighing 190 pounds, was referred to me for roentgen examination of the colon because of frequent bloody stools and early appearance of cachexia.

A barium enema was seen to traverse a large loop or redundancy located just above the middle portion of the descending colon. The entire descending colon and splenic flexure were irritable and quite spastic, having the appearance of spastic colitis. The transverse colon filled to about its middle portion; this filled part descended alongside the splenic area. There was no pinching off of the barium column that would suggest obstruction. The patient could not retain enough to fill the first half of the colon. Several examinations followed meals at dif-

ferent intervals and no deviation from normal in size, shape, position, or outline was seen in the first two-thirds of the colon. Each day the spasticity of the descending colon decreased.

On December 17, 1930, at six hours *post cibum* the barium meal was found in the terminal ileum and the entire colon. The cecum, ascending colon, and the first half of the transverse colon were to the left of the midline. The cecum was located just to the left of the midline in the pelvis (Fig. 1). At twenty-four hours *p.c.* the colon was in normal position, freely movable, and the descending colon was more regularly and normally haustrated than in October (Fig. 2).

The personal history suggests that the attachment of the hepatic flexure may have been loosened by trauma, although a congenital anomaly may account for the hypermobility. At the age of 10 years, the patient fell off a coaster, striking the abdomen on the end of the sled. At the age of 14 years, he fell eight feet off a high bicycle, striking the abdomen on a large rock. At

¹This case was reported at the staff meeting of St. Mary's Hospital, Reno, Nevada, Jan. 5, 1931.

Anderson, who reported a marked thickening and hypertrophy of the mucosa of the sub-diaphragmatic portion of the esophagus on the right side. No ulceration or fungoid

and was brought on by eating potatoes, oranges, musk melon, buttermilk, or soup. It also followed the ingestion of bread, but would disappear if the patient drank water



Fig. 2. Case 2. (A) Filling defect above the diaphragm; (B) large filling defect below the cardia; gas-filled cardia can be seen behind the defect.

growth was seen, but the area bled very easily.

On September 30, 1929, an exploratory operation was done by Dr. Brooks. A large mass was found in the lesser curvature at the cardiac end of the stomach. A definite crater could be felt. (It is possible that this crater was of the epicardia rather than of the stomach.) The case is interesting because of the early diagnosis by X-ray. This carcinoma was evidently of the ulcerating type.

Case 2. Mr. I. N., aged 64, was referred for gastro-intestinal X-ray study by Dr. S. G. Meyers, of the Gastro-intestinal Division of the North End Clinic, July 16, 1930. For two months prior to this examination the patient had complained of a burning sensation in the mid-sternum at the level of the third rib. The burning would last two or three minutes after the taking of food,

immediately after. In addition, he complained of belching, poor appetite, and constipation. He thought that he had lost some weight.

The past history revealed that the patient had been constipated seventeen years before the present examination. He had had an operation several years previously, the nature of which was not determined. He also had had some bladder trouble and on several occasions it had been necessary for him to be catheterized. The family history was of no importance.

Physical examination showed a poorly nourished male weighing 142 pounds. The eyes, ears, nose, and teeth were normal. There were a few persistent râles above the left clavicle which remained after coughing. The left heart border was 9 centimeters. The aortic second sound was accentuated over the entire precordia. There was

soft. The blood pressure, temperature, pulse rate, blood count, and urinalysis were normal. Dental, ear, nose, and throat examinations showed normal conditions.

On fluoroscopy the chest appeared nor-

mal, but nothing was noted. Gastric analysis was negative on two occasions except for a little fresh blood in the second analysis. The patient was then esophagoscoped under local anesthesia and there was



Fig 1 Case 1 (A) Defect at epicardia outlined, seen immediately after the barium meal; (B) film taken two hours after the meal, patient in semi-lateral position, niche still filled

mal. The esophagus was normal up to the point of entrance to the stomach. At this site a filling defect was seen (Fig. 1), and the patient stated that he experienced pain in this region. The stomach and cap otherwise were normal. At two hours the defect was still noted. The colon was normal.

Repeating the examination in the presence of Dr Broudo, the same defect was noted. Films confirmed the fluoroscopic findings. A film of the spine showed a hypertrophic arthritis. A diagnosis of ulcer of the epicardia, with the possibility of its being malignant, was made.

On April 2, 1929, the patient had gone to a nationally known clinic. The gastro-intestinal X-ray examination was repeated three

times, but nothing was noted. Gastric analysis was negative on two occasions except for a little fresh blood in the second analysis. The patient was then esophagoscoped under local anesthesia and there was

noted a little narrowing of the middle, but no ulcerative lesion. The mucosa on the gastric side of the cardia appeared a little more smooth than normal, and there was a trace of blood. Several consultants saw the patient but were unable to arrive at any conclusion. On April 19, 1929, he left the clinic.

On September 12, 1929, the case was seen by Dr C D Brooks, of Detroit. At this time the X-ray examination showed an irregularity of the posterior wall of the esophagus which was very suggestive of an organic lesion, probably a carcinoma of the lower end of the esophagus. On September 28, 1929, the case was subjected to an esophagoscopic examination by Dr Walter

The liver became progressively larger, firm, and irregular, and the patient complained of pain over the liver region. Later there was an enlarged gland above the left clavicle which was firm and fixed. The weakness became more marked and the man developed a terminal bronchopneumonia and died

October 17, 1930, six months after the onset of symptoms.

This case is interesting because of the peculiar appearance of the X-ray film, the presence of a probably benign lesion associated with a malignant lesion, and the rapid growth.

Colorado Sunshine. Editorial. Jour. Am. Med. Assn., March 28, 1931, XCVI, 1088, 1089.

So much is said nowadays about the dearth of sunshine and the consequent detriment to human wellbeing that it is interesting to discover some of the regions where nature's beneficent sun rays are always available in abundance. The existence of seasonal variations and their effects on the incidence of infantile rickets have been repeatedly stressed in recent years.

Tisdall and Brown found the antirachitic effect of sunshine in Toronto in April and May to be approximately eight times as great as in December, January, and February.

Day recently reported a seasonal variation in the antirachitic potency of Arkansas sunshine. According to Hess, in the tropics, rickets is almost unknown. It will be found that the intensity of rickets throughout the world corresponds in fair proportion to the amount of sunshine. Bearing in mind the varying diet of the peoples in the different

parts of the world, the dominance of sunlight in the etiology of rickets is most striking. Where the women of India are deprived of the benefit of the tropical sunshine by observing the system of purdah (screening), rickets, osteomalacia, and tetany develop. Hess has pointed out that the dominant factor in regard to the antirachitic activity of the solar rays is not so much the number of hours of sunshine as its quality and intensity.

Lewis and his co-workers believe that the relative freedom of the atmosphere from moisture and smoke offers a satisfactory explanation of the comparatively high antirachitic potency of Colorado sunshine. There is no great difference in the antirachitic effect of winter and of summer sunshine in Colorado.

The law of "the vital importance of the minimum" applies to the radiations of the sun—those rays which are furnished in smallest amount and in least intensity are nevertheless most indispensable.

CHARLES G. SUTHERLAND, M.D.

sclerosis of the peripheral vessels. No murmurs. The blood pressure was 145/90. The urine was negative and the blood count was normal. The abdomen showed a scar from a previous operation. The prostate was slightly enlarged, smooth, and not tender.

X-ray examination of the chest showed the left apex to be clear; right apex cloudy. There was evidence of Ghon's nodule in the right lung field. The heart and trachea were normal.

X-ray examination of the esophagus showed the fluid barium meal to pass readily until it reached the cardiac end above the diaphragm, where it hesitated and then passed on to the entrance to the stomach and spread out in a fan-like manner (Fig. 2), presenting large negative shadows as if the barium were going around masses. Thick barium paste hesitated a little longer. A small negative shadow was seen above the diaphragm. There was slight dilatation at the epicardia. A No. 5 barium-filled capsule was then given the patient. About two inches above the diaphragm, at the site of the negative shadow noted above, the capsule deviated anteriorly, then down, and posteriorly. It remained fixed at the entrance to the stomach for a considerable length of time, regardless of how much fluid or thick barium paste was given. The stomach and cap were normal, except as noted above. The colon was negative except that it was still filled with barium seventy-two hours later, in spite of the patient having taken a cleansing enema contrary to orders. A barium enema showed a normal contour. Films of the esophagus showed the capsule in the epicardia, still present a half-hour later. After a barium meal there was a smooth filling defect about the size of a navy bean two inches above the diaphragm and on the posterior wall. Below the diaphragm there was a large irregular filling defect which gave the impression

of a large pedunculated mass on the right side. The diagnosis was two masses in the esophagus, one above the diaphragm and one below it, probably malignant.

On July 18, 1930, the patient was esophagoscoped by Dr. W. Hudson, of the Chest Division of the North End Clinic. Just above the cardia a nodular mass covered with intact mucosa and with a smooth surface of reddish color was encountered, which was rather firm in consistency. A specimen was taken for microscopic study and marked "upper specimen." As the esophagoscope entered the cardia, ragged mucosa (vascular and fragile) was encountered. This mass was so large that it completely filled the space, rendering difficult a determination of its extent, but the impression given was that it was lateral to the cardia. A section here was also removed and marked "lower specimen." A diagnosis of carcinoma of the esophagus was made. Because of the age of the patient, Dr. Hudson was reluctant to diagnose a benign lesion.

Pathologic examination made by Dr. Plinn Morse was as follows:

Upper Specimen.—Specimen contains hypertrophied squamous epithelial cells. There is no evidence of malignancy.

Lower Specimen.—Specimen consists of a fragment of hyperplastic squamous epithelium, with underlying connective tissue and non-striped muscle bundles, also inspissated blood clot. There is also a fragment of rapidly proliferating carcinoma of small-cell type, probably primary carcinoma of the esophagus.

The patient was under the care of Dr. S. S. Altshuler, who reported that after the bronchoscopic examination the man never had a return of the symptoms of pain on swallowing, but that there was a gradual progressive weakness, with a lack of appetite, and a feeling of nausea at the sight of food. The stools were frequently tarry.

creased density of the renal shadow and the hydronephrotic process is outlined. This fact of increased density in cases of urinary obstruction interferes with the value of these preparations as determinants of renal function by roentgenologic methods. For instance, if secretion is rapid and obstruction does not occur, sufficient opaque substance may not be retained in the renal pelvis and calices for them to be outlined satisfactorily, and it may be assumed that the kidneys have been unable to excrete the substance. On the other hand, if function is impaired by obstruction, the opaque substance may be retained in the renal pelvis and the inference may be that renal function is good.

It would seem, therefore, that urography after intravenous injection of opaque substances will establish itself as an adjunct to cystoscopy and retrograde urography. It probably will be employed in the occasional case in which cystoscopy or retrograde urography is unnecessary, but chiefly in cases in which extreme irritability, advanced inflammation, or anatomic position makes catheterization of the ureters impossible.

HERMON C. BUMPUS, JR., M.D.

ANNOUNCEMENTS

SECTION ON RADIOLOGY, WISCONSIN STATE MEDICAL SOCIETY

The Seventh Annual Meeting of the Section on Radiology of the Wisconsin State Medical Society was held in Milwaukee on May 27, 28, and 29, under the Chairmanship of James A. Evans, M.D., of La Crosse. Frank W. Mackoy, M.D., of the Sacred Heart Sanatorium, Milwaukee, served as Secretary-Treasurer, and the members of the Executive Committee were, besides Dr. Mackoy, R. P. Potter, M.D., of

Marshfield, and J. C. Baird, M.D., of Eau Claire.

The program presented much of value, and attracted radiologists from beyond the limits of the State. M. J. Hubeny, M.D., of Chicago, was Toastmaster at the banquet, the address of the evening being presented by Joseph C. Bloodgood, M.D., of Johns Hopkins University and Hospital, Baltimore. B. R. Kirklin, M.D., attended from the Mayo Clinic, E. L. Jenkinson, M.D., and James T. Case, M.D., from Chicago, and Leo G. Rigler, M.D., from Minneapolis.

ILLINOIS RADIOLOGICAL SOCIETY

At the April, 1931, meeting of the Central Illinois Radiological Society, held at Peoria, Illinois, the Society voted to change its name to the Illinois Radiological Society, in order to indicate more correctly the scope of its membership. This Society was largely organized by a group of radiologists from Central Illinois in 1920, but has steadily grown and for years has had members from every section of the State.

The Illinois Radiological Society is one of the oldest state radiological societies in the West.

The officers of the Society for 1931 are C. E. Morgan, M.D., of Mattoon, *President*, and Fauntleroy Flinn, M.D., 220 South Webster Street, Decatur, *Secretary-Treasurer*.

MINNESOTA RADIOLOGICAL SOCIETY

The annual meeting of the Minnesota Radiological Society was held in Minneapolis, May 4, 1931. The following program was presented:

ROUND TABLE DISCUSSIONS

1. Therapeutic X-ray Dosage and Measurement Problems. Conducted by E. T. LEDDY, M.D., Rochester.

EDITORIAL

LEON J. MENVILLE, M.D. . . . Editor

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Radiological Society of North America.*

URINARY TRACT VISUALIZATION¹

Roentgenologic visualization of the urinary tract after intravenous injection of chemical substances has now been carried on sufficiently long to permit of its fairly accurate evaluation.

Sodium 2-oxo-5-iodo-pyridine-N-acetate, also designated as sodium 5-iodo-2-pyridon-N-acetate (uroselectan), the chemical first introduced for this purpose, like a pioneer in any field, is capable of much improvement, both from the standpoint of roentgenologic visualization and also from that of frequency of distressing reactions after administration. Reactions, it might be added, never have resulted in alarming sequels and always have been transitory. Improvements both in visualization and in diminution of reaction already have been obtained by the use of a preparation soon to be placed on the market. This preparation has a simpler chemical formula; nevertheless, it results in a much higher concentration of iodine in the urine, although less than half the dose employed with uroselectan is required.

Improvement in the preparations employed doubtless will continue, although the indications for their intravenous administration will remain approximately the same. It is apparent that any chemical given through the blood stream, because of its necessary dilution, cannot result in as satisfac-

tory or as dense a shadow as the same chemical injected through a ureteral catheter. Therefore, unless there is some contra-indication to cystoscopic examination or unless catheterization of the ureters proves impossible, better pyelograms will be obtained by injection of the substances through catheters than by their injection into the blood stream.

In diagnosis of the presence of renal or ureteral stones, in cases in which renal function is known to be normal, and marked infection has not occurred, the position of the stone can be determined definitely by employment of urography after intravenous injection of these opaque substances. In such cases retrograde urography would not give additional information. On the other hand, if urinary infection is known to be present, the intravenous method may fail to demonstrate the situation of the infection, and since catheterization of the ureters is necessary to obtain this information, pyelograms by injection through these catheters afford more accurate data.

In cases in which tumors of the kidney, or early tuberculosis, are suspected, intravenous injection as a rule does not result in a sufficiently clear roentgenographic outline to make diagnosis possible, except in very advanced cases. However, in advanced tuberculous disease, cystitis may be so extreme as to prevent ureteral catheterization. In such cases, roentgenograms after intravenous injection may be of considerable aid, even if they are not entirely definite.

When there is urinary obstruction of any kind, such as that seen in hydronephrosis or hydro-ureter, intravenous administration gives very satisfactory results. The opaque substance, by being retained, causes in-

¹Submitted for publication November 18, 1930.

and the information derived from electro-diagnosis.

III.—Chronaxia, its technic and its contribution to physiology: chronaxia in pathology.

IV.—The galvanic current and its trophic action: ionization.

V.—Electricity as an agent in gymnastics and in the treatment of muscular atrophy and neuritis; the Bergonié method: alternating waves of long periods.

VI.—Ionotherapy in the treatment of in-

fantile paralysis, cerebrospinal affections, neuritis, and neuralgia.

Fee: 500 francs (\$20).

A certificate signed by the professor in charge or the lecturers will be given after the course to every doctor who has attended regularly.

For further information and for registration apply to the Association pour le Développement des Relations Médicales, Salle Bédard, Faculté de Médecine, Paris (6).

Occupational Neoplastic Disease. Cushman D. Haagensen. *Am. Jour. Cancer*, April, 1931, XV, 641-703.

The author reviews the literature of occupational cancer, and gives statistics of his own collected from the Memorial Hospital. In this study, he discusses (1) the occupational distribution of certain types of neoplastic disease; (2) their occupational incidence; (3) the anatomic distribution of the cancers in the occupational groups, and (4) the average ages at which the tumors occurred in the different occupational groups.

Of particular interest to radiologists is occupational exposure to roentgen rays and radio-active substances. Unfortunately, the details regarding the type and length of exposure to radiation, particularly of X-radiation, are meager. A total of 20 cases is listed. Of these, 11 were roentgenologists, one radium chemist, one nurse handling radium, and two painters of watch dials with luminous paint containing radium mesothorium. There were five cases following the ther-

apeutic application of X-rays. All the cases of neoplastic disease caused by X-radiation were cutaneous cancer. In the radium group there was one case of cutaneous cancer, one case of lymphatic leukemia, and two cases of osteogenic sarcoma. The latter occurred in the watch dial painters. The average time interval between the first exposure and the appearance of carcinoma amongst the roentgenologists was fifteen and a half years. Metastases occurred in 63 per cent of these cases and death resulted in 35 per cent. The time interval between the first exposure and development of carcinoma in the cases resulting from therapeutic radiation was eleven years.

(*Abstractor's note*:—This article should be read by all those having to do with the handling of X-ray apparatus and radium. The widespread use of the fluoroscope, for instance, introduces an additional element of hazard. What the results will be, only the future can disclose.)

JOHN R. CARTY, M.D.

2. Gastric Ulcer. Conducted by J. RICHARDS AURELIUS, M.D., St. Paul.
3. Traumatic Spine Lesions. Conducted by GAGE CLEMENT, M.D., Duluth.
4. The Chest in Children. Conducted by MALCOLM B. HANSON, M.D., Minneapolis.

Informal Dinner.

ADDRESSES

The Intervertebral Disc. By EMIL S. GEIST, M.D., Minneapolis.

Pathologic and Roentgenologic Study of Joint Diseases. By R. K. GHORMLEY, M.D., Rochester.

The present officers were re-elected for the coming year as follows: B. R. Kirklin, M.D., Rochester, *President*; Gage Clement, M.D., Duluth, *Vice-president*; Leo G. Rigler, M.D., Minneapolis, *Secretary-Treasurer*.

POST-GRADUATE LECTURES IN FRANCE

Post-graduate lectures on biological problems and therapeutics concerning cancer (with practical demonstrations).—This course will be held from July 20 to 26, 1931, under the supervision of Prof. G. Roussy, with the collaboration of his staff, Prof. Huguenin, Prof. Leroux, Prof. Oberling, Prof. Verner, Prof. Sannié, Associate Prof. Mme. le Dr. Laborde, Dr. Chastenot de Géry, Dr. Y.-L. Wickham, and Dr. Bertillon.

Lectures will be delivered every day from 10 A. M. to 12 N., at the Institut du Cancer de la Faculté de Médecine de Paris, on the following subjects:

- I.—Survey of the present status of the biological problem of cancer.
- II.—Treatment of cancer by combination of radiation and surgery: statistics of re-

sults, with special reference to breast, uterus, skin, and thyroid.

III.—New facts about experimental cancer.

IV.—Culture of tissues in cancer study.

V.—Chemistry and chemical treatment of cancer.

VI.—Prognosis based on histologic study of cancer.

VII.—Social service for cancer, and anticancerous armamentarium in France.

Fee: 500 francs (\$20).

Lessons in Clinical Radiology (with lantern slides).—Demonstration of the principal and newest technics. By Associate Professor R. Ledoux-Lebard and Dr. Belot and Dr. Maingot. Hospice de la Salpêtrière, 47 Boulevard de l'Hôpital, Service of Clinical Radiology, Medical Faculty of Paris, July 20 to 26, 3 to 6 P. M.

The titles of the Lessons are as follows: (1) Roentgen exploration of the mucosa; (2) Ulcers of the digestive system; (3) Roentgen diagnosis of the urinary tract; (4) Roentgen diagnosis of genital conditions; (5) Superficial roentgenotherapy; (6) Results of deep roentgenotherapy.

Fee: 500 francs (\$20).

Lectures on Medical Electrolgy (with practical and clinical demonstrations).—By Dr. Bourguignon, Dr. Delherm, and Dr. Laquerrière, electroradiologists of the hospitals of Paris, collaborating with Dr. Vignal and Dr. Morel-Kahn, Senior Assistants. July 6 to 11, 1931, 10 A. M. to 2:30 P. M., Hôpital de la Pitié, 83 Boulevard de l'Hôpital, Paris (13). (Métro, Saint-Marcel.)

The lectures are on the following subjects:

I.—General points on the technic of electrodiagnosis (classical electrodiagnosis, chronaximetry).

II.—Relations between clinical conditions

APPARATUS

An Improvement in Grenz-ray Tubes. O. Glasser and I. Beasley. *Strahlentherapie*, 1931, XL, 389.

This is a brief description of a tube for use on low potentials of about from 6 to 12 K.V. It has a thin glass window in place of the conventional Lindemann glass. The new arrangement permits the exposure of a larger field and also has not the disadvantage of deterioration. Further experiments and additional improvements are promised.

ERNST A. POHLE, M.D., Ph.D.

The Ångström Pyranometer, Type 1930. Anders Ångström. *Strahlentherapie*, 1931, XXXIX, 526.

This is a brief description of an improved pyranometer constructed by Ångström, which serves for meteorological observations.

ERNST A. POHLE, M.D., Ph.D.

Experiments with High Voltage Tubes. T. A. Fleming. *Science*, 1931, LXXIII, 141.

The author, who is the acting director of the Department of Research in Terrestrial Magnetism of the Carnegie Institute of Washington, gives a short description of the paper on high voltage tubes by M. A. Tuve, L. R. Hafstad, and O. Dahl, which was awarded the prize of a thousand dollars at the December, 1930, meeting of the A.A.A.S. in Cleveland.

Potentials to approximately two million volts are produced by oil-immersed Tesla coils, and applied to a specially developed sectional vacuum tube made of pyrex glass, capable of withstanding this high voltage. The reflection of the beta rays produced with these tubes in calibrated magnetic fields was measured, and showed that the fastest beta rays had speeds corresponding to the peak voltage applied to the tube, thus verifying the voltage measurements. The gamma rays from the tubes were measured through one, two, and three inches of lead, with a Geiger-Mueller tube counter. With the tube operating at about 1,300,000 volts, the penetrating power of the gamma rays was found to be the same as that of the gamma rays of radium measured under the

same conditions. The tube thus produces artificial beta and gamma rays, practically covering the radium spectrum, whereby the intensity corresponds to a very large quantity of radium. These investigations, which have been developed for studies relating to atomic physics, have opened an important field for therapeutical application.

OTTO GLASSER, Ph.D.

A New and Simple Apparatus for the Production of Radium Emanation. P. M. Wolf and N. Riehl. *Strahlentherapie*, 1931, XL, 159.

This is a brief description of an apparatus for the production of radon, based on the principle that carbon absorbs emanation very easily. No complicated vacuum pump system is required. The principal parts are shown in illustrations.

ERNST A. POHLE, M.D., Ph.D.

ARTHRITIS

Chronic Arthritis. M. H. Axline. *United States Vet. Bureau Med. Bull.*, April, 1931, VII, 297.

The author analyzes 974 cases of chronic arthritis occurring in 7,000 admissions seen in the past nine years. These he divides into the intra-articular or hypertrophic type, and the periarticular or atrophic variety.

Exposure to elements outdoors and to sudden changes in temperature were outstanding etiological factors. Trauma was frequently a direct cause. Dental infections, tonsillitis, and pes planus were more prevalent in the arthritic group. The association with chronic constipation was believed to be of minor importance. Headaches, glycosuria, and tuberculosis were relatively rare. Heart affections were found more frequently in the atrophic type.

The cardinal symptoms were pain, crepitus, and loss of motion. Redness, heat, swelling, and muscular atrophy were at times present in the periarticular type. While in the hypertrophic variety because of the early bone changes a positive roentgenogram was frequent, the far advanced cases of the atrophic

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(duration, one hour), the glutathion content of the blood decreases and also the quotient glutathion/erythrocytes. It is concluded from these observations that the specific breathing function of the blood or the red blood corpuscles is increased at heights up to about 1,500 meters above the sea level, and it is very probable that exposure to the natural mountain sun decreases it.

ERNST A. POHLE, M.D., Ph.D.

A Case of Roentgen Aleukia Cured by Extirpation of the Spleen. C. Hegler and W. Griesbach. *Röntgenpraxis*, Jan. 15, 1931, III, 75.

An extensive roentgen treatment for generalized psoriasis led to a very severe damage to the hematopoietic apparatus, anemia, leukopenia, absence of platelets, bleeding from the gums and retina. Eleven transfusions kept the patient alive for six weeks, but a regeneration of the bone marrow did not take place until after the removal of the spleen. This case is the only one, to the authors' knowledge, in which a severe hemorrhagic aleukia and anemia, induced by roentgen rays, has been cured by a splenectomy. The authors advise this treatment for similar cases.

H. W. HEFKE, M.D.

BONE (DIAGNOSIS)

The Clinical and Roentgenologic Manifestations of Scurvy in a Seven-year-old Child. Joyce I. Hartman and Eugene Friedman. *Am. Jour. Dis. Child.*, February, 1931, XLI, 337.

A case of scurvy in a child of 7 years is presented to help bridge the gap in the knowledge between infantile scurvy and adult scurvy, and to show the roentgenographic differences between scurvy in the infant and that in the older child.

Roentgenograms of the left lower extremity were taken the day after the patient's admission to the hospital. The shaft of the femur and both epiphyses at the knee showed an absence of normal trabeculation of the bone, being more marked in the distal epiphysis of the femur. This epiphysis was

separated and displaced laterally. There was a slight increase in the amount of calcification at the cortical border of the diaphyso-epiphyseal line, the latter being sharply defined. Both epiphyses were surrounded by delicate lines of increased calcification. The tibia and fibula also showed a lack of normal trabeculation. Six days later, the right lower extremity showed an appearance almost identical with that of the left. The upper extremities showed no change.

Three weeks after orange juice was started, the shafts of both femora were surrounded by homogeneous, wide shadows of increased calcification, which extended from the epiphyseal lines to the region of the lesser trochanters. Calcification was more marked in the left femur and the epiphyses were in good alignment. In six weeks the epiphyses appeared firmly united, but the trabeculation of bone was indistinct. Eight months later the trabeculation of bone was more distinct.

The case is thought unusual because of the age of the patient and the absence of the most typical roentgenologic changes seen in infantile scurvy, the Gerüstmarkzone and Trümmerfeldzone.

F. B. MANDEVILLE, M.D.

An Unusual Case of a False Ball and Socket Joint. B. F. Ward. *United States Vet. Bureau Med. Bull.*, December, 1930, VI, 1075.

This is a case report of a patient who received a gunshot wound of the upper and middle thirds of the left arm, which penetrated the bone. After the bone fragments had been removed, osteomyelitis developed, but following a second operation the infection cleared up. Two and one-half years after this, roentgenograms showed evidence of union, with new bone formation and many exostoses. Subsequent roentgenograms made two and one-half years later showed that the union was not firm. The appearance was that of a false joint. Examination made eight years after the injury revealed a preternatural mobility of the left humerus at the point of fracture, with no evidence of nerve involvement. The author believed that a weak union followed the sec-

type very often showed no manifestations on the X-ray film.

In the treatment of these cases the author advises the clearing up of foci of infection, the correction of deformities, and the proper regulation of diet. Exercise, when carefully given in selected cases, proved beneficial. Medication consisted of arsenic and quinine used internally, and analgesic balms externally. The use of salicylates in the chronic group was discarded, and foreign protein injections were uncertain in their results. Deep therapy, ultra-violet, massage, passive motion, interrupted galvanic current, cabinet baths, and whirlpool and Scotch douches were the forms of physiotherapy employed. The author stresses the importance of adequate knowledge of the proper application of physiotherapy and a most careful selection of cases. The routine employed, which was varied at times, was as follows: For the hypertrophic type, from 20 to 30 minutes of diathermy followed by from 10 to 20 minutes of deep therapy; for the atrophic type, from 20 to 30 minutes of deep therapy followed by ultra-violet rays for from 5 to 10 minutes.

J. N. ANÉ, M.D.

The Etiology of Rheumatoid Arthritis. Russell L. Cecil, Edith E. Nicholls, and Wendell J. Stainsby. *Am. Jour. Med. Sci.*, January, 1931, CLXXXI, 12.

The authors have carried out extensive experiments in an attempt to determine the etiological organism producing typical rheumatoid arthritis.

They consider the following questions:

1. Is rheumatoid arthritis an infection?
2. If rheumatoid arthritis is an infection, is it a streptococcal infection?
3. If it is a streptococcal infection, how do the streptococci gain access to the joints?

They subjected 154 cases to blood cultures, finding 96, or 62.3 per cent, yielding short-chained streptococci. In 49 cases, cultures were made from one of the affected joints, 33, or 67.3 per cent, showing short-chained streptococci. Thirty-seven out of 48 cases subjected to both blood and joint cultures showed streptococci in either the blood or the

affected joint. They were able to reproduce in rabbits a rheumatoid arthritis, with typical strains of streptococci, having a striking similarity of histological changes to those in human rheumatoid joints.

The conclusions the authors have drawn from these experiments and observations would seem to indicate that rheumatoid arthritis is the result of a streptococcal infection from a focal infection elsewhere in the body.

ROE J. MAIER, M.D.

BLOOD CHANGES

Contribution to the Biologic Effect of Roentgen Rays. G. Schaal, M. A. Gruschetzkaja, and E. J. Zwilichowskaja. *Strahlentherapie*, 1931, XL, 111.

The potassium-calcium quotient in the blood serum changes following exposure to roentgen rays. An analysis of 20 patients showed that the change is apparently dependent upon the time interval between the exposure and the blood examination. During the first few days following treatment, the potassium is increased and after that the calcium. It might be possible to explain some of the phenomena as X-ray sickness, early reaction, fluctuation of the leukocytes, and the analgesic effect of roentgen rays by this variation of the potassium-calcium ratio.

ERNST A. POHLE, M.D., Ph.D.

The Glutathion Content of the Blood in the Mountains and Following Irradiation with Mountain Sun. J. von Deschwanden. *Strahlentherapie*, 1931, XXXIX, 278.

Glutathion, a tripeptid, discovered by F. G. Hopkins, seems to play an important rôle in the oxygen metabolism. The author studied its behavior in rabbits following exposure to sunlight. He found that the glutathion content of the blood and of the red blood corpuscles is increased at heights of from 1,300 to 1,500 meters above the sea level. The quotient glutathion/erythrocytes is increased in these heights, which means that the glutathion content of the red blood corpuscles is also increased. Following exposure to the sun

be generalizations in the relation of metabolism to the histological and clinical details.

The authors studied a series of cases of human mammary carcinoma by these methods, and the material comprised tumors of varying degrees of cellularity, differing in type and arrangement, and with different degrees and types of connective tissue response. The metabolic investigations were, therefore, combined with a histological study of the tumors. In addition to the tumor tissue, two portions of breast showing intraductal epithelial hyperplasia were examined, and one case of chronic cystic mastitis and a portion of unchanged breast tissue near the growth. The material was obtained immediately after surgical removal. As a rule, the time intervening between the removal of the specimen and the commencement of preparation of the material did not exceed from five to ten minutes, and, as a rule, the readings were begun under forty minutes from the time of removal of the tissue by the surgeon. The improved method of Warburg was used in all experiments, and, so far as possible, duplicate estimations were made. The character and arrangement of the actual carcinomatous tissue was noted, and also the degree and type of connective tissue response.

As an index of the proportion of carcinoma to connective tissues, the number of carcinoma cells in 200 standard fields of 1/40 square millimeter was counted, and an average per field thus obtained, which was known as the "carcinoma cellularity index." In the case of the connective tissues, the amount of fibroblastic and elastic tissue reaction was noted, and the degree of small round-cell infiltration. The main clinical and pathologic features of the 20 cases examined, together with the metabolic findings, are given in the tabulation. The metabolic reactions of the human mammary carcinomas correspond, on the whole, with those of animal tumors in showing a large amount of aerobic lactic acid production, but the authors point out that, whereas, with the transplantable animal tumors one is dealing with homogeneous material almost entirely composed of tumor cells, in the human material studied the issue was complicated by the

varying cellularity of the different tumors. Therefore, the technical difficulties were greater in dealing with the human tumors, and the figures obtained showed a wider variation.

The authors conclude that the two chief histological factors which can be correlated with this variability are: (1) The amount of actual carcinomatous tissue present, and (2) the degree of inflammatory cell stromal reaction, but owing to the great variations in metabolism associated with these factors, it is at present impossible to attempt to correlate the clinical with the metabolic findings. It is recommended that any one studying the metabolic processes of carcinoma, especially those in the human, take into consideration the amount of round-cell infiltration present, as well as the presence or absence of proliferating fibrous tissue cells, as these both introduce complications of considerable importance.

H. J. ULLMANN, M.D.

The Diagnosis of Cancer of the Larynx. Sir St. Clair Thomson. *Jour. Laryngol. and Otol.*, January, 1931, XLVI, 31.

Tuberculosis is more often mistaken for cancer of the larynx than any other condition. The author states as follows:

"The converse mistake of diagnosing an intrinsic cancer as tuberculosis is not made so often, but it is becoming more frequent since many medical men have taken to basing their diagnosis chiefly on the X-ray film, and radiographers are so often ready to convict all mankind of tuberculosis!"

CANCER (THERAPY)

Cancer of the Larynx. Simon Jesberg. *California and Western Med.*, April, 1931, XXXIV, 246.

This article is written to show the few cases of cancer of the larynx found in Los Angeles, as compared with the average number per 100,000 population found in other reports. Whereas statistic averages indicate from 29 to 70 cases per year, the hospital records for a ten-year period show but 18 operations for laryngeal carcinoma. Early diagnosis is stressed and the surgical treatment is outlined.

ond operation and that because of the abnormal mobility and the friction of the two fragments an anomalous joint resulted. The upper fragment assumed the characteristics of the ball because of the greater range of motion of the shoulder joint. The lower fragment, having the more stable elbow, formed the socket.

J. N. ANÉ, M.D.

BONE TUMORS (DIAGNOSIS)

The Limitations in the Demonstrability of Bone Tumors. W. Baensch. *Röntgenpraxis*, April 1, 1931, III, 325.

A destructive area in a bone must reach a certain size before it is visible in roentgenograms. Films taken of the tibia in a case of bone sarcoma were repeatedly negative, while on operation a rather extensive tumor was revealed. Chasin has shown that defects in the spongiosa of the vertebral bodies as large as 1 or 1.5 c.c. were not visible. The author removed as much as 0.75 c.c. of the spongiosa in the tibia without being able to detect these areas on a roentgenogram. If only a very thin sliver of the cortex is removed (0.5 mm.), this area can be shown definitely on the film. The author is of the opinion that relatively large defects in the spongiosa cannot be shown roentgenographically, while relatively small defects in the cortex are easily shown.

H. W. HEFKE, M.D.

Two Cases of Bone Tumor from Ancient Egypt. R. A. Gardner and A. L. Urquhart. *British Med. Jour.*, Aug. 9, 1930, No. 3631, p. 211.

These cases are interesting as throwing some light on the nature of the diseases which were present among the ancient Egyptians and about which so little is known.

The first specimen, the femur of a young person, belongs to the Ptolemaic period, and, macroscopically, shows certain areas of typical bone spicule formation of osteosarcoma. A roentgenogram clinches the diagnosis by showing the typical architecture of the growth, and one can thus exclude definitely such a condi-

tion as chronic osteomyelitis, which might be suggested by the gross naked-eye appearance. For comparison, a roentgenogram of a similar osteosarcoma in a present-day hospital patient is reproduced.

The second specimen, from a grave of the pre-dynastic period, and, therefore, probably not less than 5,500 years old, is one of the earliest yet found amongst the former dwellers of the Nile valley. The tumor occurs on the left side of the mandible, and a photograph and roentgenogram of this interesting specimen are reproduced. The diagnosis of this condition cannot be definitely established, but the possibilities of a myeloid epulis, a dentigerous cyst, a simple cyst, or a fibroma should be considered; of these, the first appears to be the most probable.

WALLACE MACKENZIE, M.D.

CANCER (DIAGNOSIS)

Observations on the Metabolism of Human Mammary Carcinoma. Frank Dickens and David H. Patey. *Lancet*, Dec. 6, 1930, CCXIX, 1229.

The authors first refer to the metabolic studies of Warburg and his collaborators, showing that the two fundamental processes occurring in cells are respiration and glycolysis. These two processes are related by a more or less quantitative coupling, so that an increase in the value of respiration results in a corresponding diminution in the aerobic glycolysis. In most normal tissues the aerobic glycolysis is small or zero. Warburg's earlier work suggested that tumors might be classified metabolically on the basis of the relation of the respiration to the glycolysis, but the more recent work of Murphy and Hawkins, 1925, and Crabtree, 1929, has shown that this is not generally true. In addition to this, certain granulomatous overgrowths, as well as the retina and mammalian erythrocytes, are characterized by the production of a considerable amount of aerobic lactic acid. It is, therefore, clear that aerobic glycolysis is not a specific feature of tumors, and there is a present need for more experimental observations on a comparable series of tumors to see if there may

lation, followed by radium, and then treated with X-rays to the lymph drainage areas; this technic has given the highest percentage of cures. Lesions of the tongue, floor of the mouth, and buccal mucosa are always serious. The authors prefer interstitial irradiation with or without electrothermic methods, with external radiation to the lymph glands.

Transitional-cell epidermoid carcinomas, usually found at the base of the tongue or on the tonsil, respond readily to irradiation and should be treated by this method.

Melanomas should be widely resected by a high frequency knife at the first sign of the growth, irradiation being used only pre-operatively.

For sarcomas of the skin (primary), the best results follow a combination of surgery and radiotherapy, the radiation dose being the same as for prickle-cell carcinoma.

W. W. WATKINS, M.D.

Radiation Therapy of Carcinoma of the Respiratory Tract: Report of Cases. Orville N. Meland. *California and Western Med.*, March, 1931, XXXIV, 165.

The author divides the respiratory tract into the upper or larynx, the middle or trachea and bronchus, and the lung proper. In carcinomas of the larynx, the consensus of opinion is that surgery is the treatment of choice in the intrinsic type. When there is involvement of the glands, the patient is referred for irradiation, although practically always the results are palliative rather than curative. There were a few five-year cures from radium alone. The causes of failure in the early lesions are given by the author as follows:

"1. The resistant type of cell that is the basis of the growth in this locality.

"2. Imperfect distribution and calculation of dosage.

"3. Relying on irradiation alone."

In carcinoma of the trachea and bronchus, the diagnosis is made by means of the bronchoscope and biopsy, but the treatment must rest largely with the radiologist, and here the use of radon implants is recommended.

Primary carcinoma of the lung is of two types, namely, the aveolar, at the periphery,

and the bronchogenetic, found at the hilum. The former is highly resistant to irradiation and the latter very sensitive. All should be given irradiation therapy, however, for some which at first appeared hopeless have disappeared after thorough irradiation, but this has been of but little avail in the metastatic carcinomas of the lung.

F. B. SHELDON, M.D.

CHEST (DIAGNOSIS)

Pericarditis with Effusion. Lucy Porter Sutton. *Am. Jour. Dis. Child.*, January, 1931, XLI, 78.

The author states as follows: "In considering the diagnosis of pericardial effusion, two facts must be kept in mind: (1) Contrary to earlier teaching, the heart does not change its position materially in the presence of effusion. The attachments are so firm, and the heart so completely fills the space between the anterior wall of the chest and the spinal column, that it is impossible for it to sink downward and backward, as was formerly assumed to be the case. Curschmann and others showed clearly that in the presence of effusion, the heart, except possibly the apex, maintains its position in relation to the anterior wall of the chest. (2) An inflamed pericardial sac is distensible far beyond the capacity of a normal pericardium."

Because of the attachments of the great vessels, and the fact that the heart lies a little more to the left than to the right side of the chest, the left pouch of the pericardium becomes more distended with fluid than does the right, and eventually the pericardium comes in contact with the posterior wall of the chest on the left. The signs thus produced range from dullness to flatness on the left side of the chest from the angle of the scapula down. Over all or part of this area there is bronchial breathing, usually intense, with bronchophony or egophony. Tactile fremitus persists, but may be diminished, and frequently there are fine râles just above the area of dullness and bronchial breathing.

The author has studied eight cases of pericarditis with effusion, and in every case a roentgen shadow, characteristic of pericardial

Irradiation therapy is held to be palliative and is used only in inoperable cases.

There is a lengthy discussion by Rulon S. Tillotson and Orville N. Meland.

F. B. SHELDON, M.D.

Our Clinical Experience with Cancer of the Vulva. M. Tausch. *Strahlentherapie*, 1931, XL, 44.

During the past twenty years, 32,415 patients were seen in the Women's Clinic of the University of Tübingen; 54 of these, or 0.17 per cent, had cancer of the vulva. In 50 patients, the tumor was primary, while in the remaining four, it was metastatic. Nine of the primary cases represented recurrences which had been treated previously elsewhere. The disease occurred mostly between the ages of 60 and 70. There was no definite relation between cancer of the vulva and leukoplakia or kraurosis. Twenty-five patients had enlarged regional glands; 11 of these were resected but only in eight cases could a histological diagnosis of cancer be made. They were mostly squamous-cell carcinoma, with cornification. Of the 41 primary cases, two left the clinic untreated. Of the remaining 39 patients, 19 were operated on, seven were operated on and irradiated, and 13 irradiated only (seven patients, X-ray only; five patients, X-ray plus radium; one patient, radium only). The technic of radiation was: Deep therapy over five areas, 1 E.D. each, at 30 cm. F.S.D.: 23.1 mg. radium element filtered through 1 mm. brass, plus 0.3 mm. Ag applied in contact for 48 hours. Of the 19 operative cases, one patient died following operation, and one could not be traced. Twelve remained under observation less than five years. One of these is alive, nine have died from cancer, and two have died from other diseases. Five patients were observed longer than five years: one is alive, three are dead from cancer, one died from another disease. Seven patients were operated on and then irradiated. Five of these were observed less than five years: four died from cancer, one from another disease. Two were observed longer than five years and both are still alive. Thirteen patients were treated by radiation; one could not be traced. Eleven were ob-

served less than five years: two of these are still alive, and nine have died from cancer. One was observed over five years and died finally from the carcinoma.

No detailed data are given concerning the nine patients who came in with a recurrence after being treated in another clinic. Of the four secondary carcinomas, three had the primary type in the fundus, and one in the vagina. They were all treated with a combination of roentgen and radium rays. One case could not be traced, one died four and a half years after the treatment from a recurrence, two are still alive, one for a period of eight years, and the other for thirteen and a half years.

Although the author contends that his material is not sufficient from which to draw far-reaching conclusions, he is of the opinion that cancer of the vulva is very malignant and apt to recur many years after the treatment.

ERNST A. POHLE, M.D., Ph.D.

Treatment of Skin Cancer. Joseph J. Eller and Everett C. Fox. *New York St. Jour. Med.*, Nov. 15, 1930, XXX, 1344.

Before outlining the therapeutic procedure in the treatment of cutaneous newgrowths, an effort should be made by microscopic study to determine the degree of malignancy and radiosensitivity. X-ray and radium are important agents in treating skin cancer, either singly or combined with various surgical procedures.

In basal-cell epitheliomas, the authors confirm the good results reported by MacKee, who used X-rays, and Quick, who used radium, finding them about equal in value. They use unfiltered X-rays as a rule, $2\frac{1}{2}$ or 3 skin units at 100 K.V., repeating the dose, if necessary, two weeks after all reaction has subsided. Where cartilage is involved, the lesion is first removed by the high frequency knife or electrocoagulation.

In prickle-cell epitheliomas, the treatment varies with the location and character of the lesion. Early lesions on the trunk or limbs may be treated successfully by radiation alone, though it is usually best to remove them surgically or destroy them by electrocoagulation. Lip lesions are best destroyed by electrocoagu-

in the present case, be made from the X-ray and laboratory findings.

Irradiation therapy, in this case, to the lower mediastinal area, improved the general appearance, appetite, and weight, and lessened dyspnea and the amount of fluid in the chest.

F. B. SHELDON, M.D.

Roentgen Diagnosis of Small Pleural Effusions. Leo G. Rigler. *Jour. Am. Med. Assn.*, Jan. 10, 1931, **XCVI**, 104-108.

With improvement in roentgenoscopic and roentgenographic technic the early diagnosis of small pleural effusions can now be made.

By physical diagnostic methods it is almost impossible to detect small effusions. On the Continent, especially where roentgenoscopy is the method commonly used, eccentric positions of the X-ray tube with relation to the fluorescent screen have been used to obtain visualization of small effusions. This method alone is difficult and the results are frequently indefinite. The majority of observers state there is little or no shifting of pleural effusions with change in position of the thorax. Lenk's conclusions, based on roentgenoscopic observations, indicate that pleural exudates as well as transudates move freely when the patient is moved from the upright to the prone position.

Patients in whom there was evidence of pleural effusion in the usual upright or prone postero-anterior roentgenogram were roentgenographed in a variety of positions, namely, upright, prone, supine, and lying on either side. The free movement of all pleural transudates and most of the pleural exudates was definitely established. Only those cases in which there was a large amount of fibrin or numerous pleural adhesions or an exudate of the thick plastic type showed no shifting.

To produce the change in position of the fluid from the pleural sinus below the dome of the diaphragm to the lateral portion of the pleural cavity, the lateral decubitus position is most advantageous. In this position, fluid could readily be detected when it was invisible in the usual upright or reclining positions. The shadow of the interlobar fissure, due to gravitation of the free fluid into the interlobar fissure, was changed from a thin

line to a dense triangular shadow, giving an added differential factor between pleural thickening and fluid.

Sante, in the discussion, stressed the practical importance of the author's work as the roentgenographing of the patient with the affected side down.

CHARLES G. SUTHERLAND, M.D.

Syphilis of the Lungs. Heinrich Hammer. *Röntgenpraxis*, April 1, 1931, **III**, 301.

Recognition of syphilis of the lungs is very difficult. A review of the literature reveals only a few cases which have been verified by autopsy. A rather fast disappearance of infiltrations after iodine medication or salvarsan treatment does not prove the presence of lung syphilis. Tuberculosis, chronic pneumonias, abscesses, tumors, and echinococci must be considered from a differential diagnostic standpoint. A localization in the midportion of the chest and the absence of calcification are of some value for the diagnosis.

Two cases are described, with clinical histories and roentgenologic and autopsy findings. The first case presented a compact dense shadow, extending from the right hilum into the lung, with some infiltration in the left hilum, small cavities being visible in this area. Neoplastic infiltration or syphilis was suspected. The pathologic anatomic diagnosis was gummatous lung syphilis. The second case showed an intense, homogeneous shadow over the lower half of the right lung, gradually decreasing in density toward the periphery. A tumor was suspected. The pathologic anatomic diagnosis was gummatous syphilis of the lung and liver.

H. W. HERKE, M.D.

Pneumoconiosis in Iron Miners. George B. Lawson, W. P. Jackson, and J. E. Gardner. *Jour. Am. Med. Assn.*, April 4, 1931, **XCVI**, 1129-1131.

Lanza gave the life expectancy of a metal miner, from the time he commences hard rock mining and including one year of disability immediately preceding his death, as 9.6 years. His description of miners' phthisis is classic: the chief symptom is dyspnea on exertion,

effusion, was found. The pulmonary fields, as shown by roentgenograms or fluoroscopy, have been clear, thus excluding the presence of pleural fluid. Fluid has been obtained by thoracentesis in the seventh or eighth space posteriorly.

The author concludes that the physical signs described by her constitute in themselves evidence of the presence of pericardial effusion, and if any doubt exists, fluoroscopy or X-ray films will clear it up.

F. B. MANDEVILLE, M.D.

Roentgenologic Observations on the Movement of Pleural Effusions. Leo G. Rigler. *Am. Jour. Roentgenol. and Rad. Ther.*, February, 1931, XXV, 220.

In an analysis of a series of cases of fluid in the pleural space, the author has found that all transudates and most serous effusions move freely within the pleural cavity with change in position of the patient, while purulent effusions and some serous exudates fail to change position, even though the patient be inverted. He advocates the postero-anterior film, with the patient lying horizontally on the affected side, to demonstrate small effusions which, with the patient in any other position, would fail to manifest themselves.

J. E. HABBE, M.D.

Studies of Atelectasis. E. Korol. *United States Vet. Bureau Med. Bull.*, January, 1931, VII, 10.

The author discusses the etiology, mechanism, physical signs, roentgenographic findings, and postmortem appearance of atelectasis.

Atelectasis may be caused by any interference with the normal interchange of air in the lungs. The causes mentioned included obstruction of a bronchus by a foreign body, tumor, inspissated mucus, or cicatrization of a tuberculous ulcer within or by pressure from without, such as in aneurysm of the aorta, primary malignant tumors of the hilum glands, intrathoracic Hodgkin's disease, and leukemic masses. Other conditions of etiological importance mentioned were: injury to nerves supplying respiratory muscles, severance of

attachments of muscles of respiration, accumulation of fluid in the pleural cavities, circulatory disturbances, or inflammatory or degenerative diseases of the pulmonary parenchyma.

The normal negative tension in the pleural cavity is due to the relative disproportion in size between the chest and lungs. In atelectasis there occurs an increase in the negative pressure on the affected side. The intra-abdominal pressure of one atmosphere is responsible for the elevation of the diaphragm. The atmospheric pressure on the outside of the chest causes crowding of the ribs and deviation of the sternum and spine. In like manner, the pressure in the opposite pleural cavity induces the displacement of the mediastinum to the affected side. These findings are more pronounced during inspiration because at this time the chest increases in size and the collapsed lung cannot inflate to fill the affected side.

The author discusses the occurrence of bronchiectasis in atelectasis. This was believed to be due to the accumulation of secretions from lack of drainage in the obstructed portions of the bronchial tree.

The roentgenogram reveals the following: Retraction of the affected chest, with collapse of the ribs; elevation of the diaphragm on this side, deviation of the mediastinum to the affected side, and evidence of bronchiectasis. Pneumonia or pleural effusion may be simulated if the atelectatic lobe is consolidated. In pleural effusion, however, the mediastinum is deviated to the opposite side.

Case records of atelectasis with aortic aneurysm, mediastinal tumor, leukemia, Hodgkin's disease, and post-operative massive atelectasis are reported.

J. N. ANÉ, M.D.

Chylothorax: Report of Case. Roscoe G. Van Nuys. *California and Western Med.*, April, 1931, XXXIV, 269.

The author reports a case of chylothorax, the etiology of which is not clear. The general etiology of this condition, diagnosis, and treatment are discussed. Most diagnoses may, as

inculcated into every medical student. The wheezing referred to is that heard at the open mouth of the patient—not by auscultation through the wall of the chest.

Conditions in which wheezing occurs are listed under the following headings: (1) Compression stenosis, such as foreign bodies in the esophagus, thymic compression, substernal goiter, and adenopathy; (2) bronchial obstruction of the by-pass, check-valve, or stop-valve types, due to cicatricial stenosis, foreign bodies in the air or food passages, subglottic laryngitis, papillomas, pulmonary abscess, bronchiectasis, and, lastly, asthma. The obstruction in the last three conditions is due to the secretions present.

The author concludes that if a patient presents a wheeze, there is always some obstruction in the larger air passages, that most often a foreign body is the cause of the obstruction, and next in frequency is a secretion. He does not believe that obstruction in the smaller bronchi causes wheezing, audible at the open mouth. In his opinion, bronchoscopic examination always reveals the mechanical cause of the wheezing, and co-operation of the pediatrician, roentgenologist, and broncho-esophagoscopist is all-important.

F. B. MANDEVILLE, M.D.

CONTRAST MEDIA

A New Method for the Roentgenologic Demonstration of the Liver and Spleen by Injection of a Contrast Medium (Hepato-Lienography). P. Radt. *Med. Klinik*, Dec. 19, 1930, XXVI, 1888.

Certain colloidal substances, given parenterally, are deposited in the reticulo-endothelial system, especially in the liver and spleen. A thorium-dioxide-sole (made by the chemical works of Heyden) was used and proved to be harmless for animals and human beings. From 40 to 80 c.c. were given to human beings, injected in doses of from 10 to 20 c.c. daily. Occasionally a slight malaise was noticed three or four hours after the intravenous injection. All animals which were used for these experiments over a year ago are still alive. Histologic examination did not show any anatomical changes, except the presence

of small yellow granula in some cells, which is the thorium-dioxide. Blood and urine examinations were normal in the animals as well as in the human beings.

The liver and spleen in normal individuals are shown plainly in the roentgenograms as rather dense shadows. Twenty patients have received thorium-dioxide. Four cases are described and the roentgen films are reproduced. Negative round shadows in the liver in the first case proved to be caused by carcinomatous nodules (autopsy). In the second case there was a good contrast shadow of the spleen, but almost none of the liver. A liver cirrhosis was suggested by these findings and confirmed by autopsy. The third case again showed multiple round filling defects of the liver, caused by metastases of a pancreatic carcinoma (autopsy). The same was found in another case. The author hopes that this new method may lead to progress in the diagnosis of many diseases of the liver and spleen.

H. W. HERKE, M.D.

The Practical Use of Varicography. Max Wolf and Franz Remenovskiy. *Wien. klin. Wchnschr.*, March 13, 1931, XLIV, 353.

Abrodil was used for the roentgenologic demonstration of varicose veins and proved to be harmless. The authors show that in most cases the direction of the blood flow in superficial varicosities is mainly toward the periphery (contrary to the deep veins). In some cases they succeeded in demonstrating the deeper veins, which is of some importance after a deep-seated phlebitis. Even when using the exact technic (compression, direction of needle, metal rings, etc.), it was impossible to retain the solution in a certain part of the vein for any length of time.

H. W. HEFKE, M.D.

The Use of Lipiodol. R. C. Shawhan. *United States Vet. Bureau Med. Bull.*, December, 1930, VI, 1049.

The author mentions the value of the use of lipiodol in the following conditions:

1. Pathologic conditions of the chest, such as bronchiectasis, lung abscess, cavitations, and tumors.

gradual in onset, sometimes preceded by a bronchitis—more often not. As fibrosis advances, the dyspnea becomes urgent and disabling. The patients show nothing in appearance comparative to their conditions. Physical signs were inadequate, apparently, to account for the symptoms in all but the advanced cases.

A study was made of seventeen air drill operators, who had run drills from three to eight years, with little protection of any sort. After a year or so of work, slight dyspnea became apparent and was more noticeable in the early morning. This moderate dyspnea seemed not to increase appreciably for a period of from six to eight years, when there developed rather rapidly a severe dyspnea, even though the worker had been in the open during the last few years. Several men developed a severe dyspnea after they had been away from the dust in the mines as long as seven years.

The fact that such operators at the time of their retirement from years of exposure to iron and silica dust have no symptoms may have little bearing on the future progress of their disease.

Analysis of the ash in one lung showed silicon dioxide, 17.28 per cent; ferric oxide, 51.58 per cent, and phosphorus pentoxide, 19.31 per cent.

CHARLES G. SUTHERLAND, M.D.

CHEST (GENERAL)

Pathology of the Superior Mediastinum. Fanconi. *Schweiz. Med. Wchnschr.*, March 7, 1931, LXI, 229-231.

The roentgenogram of the superior mediastinum is the result of the superposition of the sternum, thymus, large vessels, and the vertebræ, and its outline may be disturbed by variations in any of these structures. Narrowing may be due to any one of many conditions, but is particularly characteristic of transposition of the great vessels. Other congenital heart lesions may produce a widening of the superior mediastinum, but the chief cause of increased width is thymic hypertrophy.

The author discusses the clinical and roent-

genologic characteristics of thymic enlargement. Another cause of widening of the superior mediastinum is mediastinitis. The significance of various lines within the mediastinal outline is then discussed in detail.

H. C. OCHSNER, M.D.

Should the X-ray Displace the Physical Examination of the Lungs? G. O. Bassett. *United States Vet. Bureau Med. Bull.*, February, 1931, VII, 146.

This question is asked in all seriousness for it seems to be more and more the tendency, due to the rapid advance in X-ray technic during the past decade, to look for an interpretation of chest pathology in the X-ray laboratory. To-day, X-ray technic is established, and with this has come a certain positiveness of opinion from radiologists that is often accepted by clinicians.

The fault lies, the author thinks, not so much with the radiologist as with the clinician. The conservative roentgenologist, appreciating the possibility of error, has never varied from the careful "it suggests" in his report. But the clinician, following the advancements in radiology, has leaped ahead, accepting as fact the infallibility of the X-ray.

The art of interpreting the pathology of the chest by auscultation, aided by observation and manual examination, is tending, in the author's opinion, to become a lost art. Skill is difficult to acquire for it exacts careful study and continuous practice.

The author's contention is that the clinician should make the physical examination first. Having thereby obtained his own mental picture of the pathology present, he should next check the findings with the radiologist, studying the films with him. An intelligent co-operation of this sort is highly advisable.

J. N. ANÉ, M.D.

Wheezing Respiration in Children: Bronchoscopic Observations on Stridorous and Asthmatoïd Breathing. Chevalier Jackson. *Am. Jour. Dis. Child.*, January, 1931, XLI, 153.

The author believes that the aphorism "All is not asthma that wheezes," should be

in length and 2.9 mm. in diameter, containing 5 milligrams of radium element. The silver screen was 0.2 mm. thick. It is stated that a similar applicator, containing 10 milligrams of radium equivalent, if placed directly on the skin, produced a mild erythema in fifteen minutes and a definite erythema in twenty minutes. The results are represented in numerous curves. It is concluded that the sensitivity can be compared on the basis of the inhibition in growth. Both sensitivity and latent time are definitely related to the velocity of proliferation. This holds for malignant as well as for normal cells.

Tissue cultures with experimentally reduced growth do not show any effect to small doses of radiation. After heavier doses which are, however, not lethal, the cultures slowly recover from the effect. Occasionally a temporary increase of growth was noted in the irradiated cultures, as compared with the controls. Preliminary irradiation followed by repeated transplantation of the cultures resulted in an increased sensitivity. Repeated irradiation of previously irradiated cultures does not increase the inhibition of growth. The biologic susceptibility of the cells as measured by the inhibition of growth corresponds to the product of time and intensity of irradiation. Carcinoma cultures show a particularly high sensitivity if irradiated first and then transplanted repeatedly. This is not regarded as a qualitative but a quantitative difference from normal cells.

ERNST A. POHLE, M.D., Ph.D.

The Rôle of the Parathyroids in Calcification, and Susceptibility of Parathyroidectomized Rats to Viosterol. David H. Shell-ing. *Proc. Soc. Exper. Biol. and Med.*, December, 1930, XXVIII, 307.

The author noted that parathyroidectomized rats were more susceptible than normal rats to hypercalcification when produced by viosterol or by diets containing calcium and normal or high phosphorus concentrations. The effect of viosterol hypercalcification in the parathyroidectomized animals was absent on a very low calcium intake, and more pronounced on a high phosphorus and optimal calcium diet.

The possible relationship of dysfunction of the parathyroids to the abnormal calcification, such as in Paget's disease, juvenile sclerosis, renal sclerosis, otosclerosis, and general arteriosclerosis is mentioned.

J. N. ANÉ, M.D.

Experimental Induction of Tumors with Blast-furnace Tar. I. Berenblum. *The Lancet*, Dec. 20, 1930, CCXIX, 1344.

These experiments were the outcome of investigations originally undertaken to discover the reason for the failure of certain tars to induce tumor growth. The prevalent view is that the carcinogenic action of tars is due to certain "specific carcinogenic principles" contained, and, conversely, that those tars which are ineffective are deficient in these substances. The author had previously found that an active gas-tar could be rendered almost completely non-carcinogenic by the addition of 0.1 per cent of mustard gas (dichloroethyl sulphide), and that the inhibition was due to some action of the chemical on the animal, and not to any alteration of the tar itself. This suggested that a particular tar might appear to be non-carcinogenic, not because it lacked substances which were responsible for the tumors, but because the action of those constituents was masked by the presence of an inhibitory substance. The present investigation to test this hypothesis proved unsuccessful, because the extract of blast-furnace tar, which was assumed to be non-carcinogenic, actually produced tumors when applied to the skin of mice.

Up to this time, blast-furnace tar has always been considered to be entirely lacking in carcinogenic power, and this view is based on both clinical and experimental evidence. Epitheliomatous lesions of the skin are not uncommon among workers in gas-tar factories, but no such lesions have been observed among those who are in daily contact with blast-furnace tar. There is no record at the Home Office of a case of skin malignancy from blast-furnace tar, although there are 520 (with 79 deaths) reported from pitch and tar in the ten years from 1920 to 1929, and the total from pitch, tar, paraffin, and oil during the same

2. Gynecologic conditions, such as kinks and stenosis of the fallopian tubes, certain uterine conditions, and sterility.

3. Diseases of the vascular system; to locate obstruction, thrombi, and phlebitis.

4. Neurologic conditions, such as cord and brain lesions.

5. Visualization of the vas deferens and seminal vesicles.

6. Outlining of normal anatomy in the living subject.

The visualization of the lung fields and bronchial structures are discussed in detail. Supraglottic, intrabronchial, and cricothyroid injections are the methods of administration. The author expresses his preference for the supraglottic, because of its simplicity and ease of administration.

While in some cases one-fourth grain of morphine may be used about one-half hour before the injection, atropine should never be used because the dryness it induces is not desirable. The soft palate, base of the tongue, epiglottis, and larynx are anesthetized with a 10 per cent cocain solution. The patient is instructed to protrude his tongue, grasp it with a piece of gauze, and draw it forward. Using a warmed laryngeal mirror, the laryngeal syringe is introduced into the larynx, retracting the epiglottis slightly forward with its tip. In this manner, 15 c.c. of warmed iodized oil is injected during quiet respiration. The patient should then be examined in several positions by fluoroscopic and radiographic means. In bronchiectasis the shadows appear clubbed and beaded.

J. N. ANÉ, M.D.

Contrast Filling of the Knee Joint with Uroselectan. Lorenz Michaëlis. *Röntgenpraxis*, April 1, 1931, III, 320.

The demonstration of the knee joint, especially the cartilage, has been tried by injection of iodipin (iodinized oil) and air. Both have proved very unsatisfactory. Uroselectan seemed to offer all the advantages for a contrast medium which could be injected into the joint, and was tried in twelve patients. The technic is simple: From 40 to 60 cm. of a uroselectan solution are injected into the joint.

Stereoscopic films are then taken immediately after the patient has flexed and extended the knee several times. Rest for 24 hours afterwards is advisable. The injection is harmless, and only one patient reacted with a slightly elevated temperature for 24 hours; occasionally some pain in the knee was noticed, which, however, did not last long. One hour after the injection, the density of the contrast medium is already definitely lessened and after from 3 to 5 hours it cannot be demonstrated. The density is not marked enough to obscure the bone, and the aqueous solution allows a uniform distribution in the joint. Its use is indicated in all chronic or recurrent cases of exudates in the knee or in cases of injury to the cartilage, but not in acute cases. It seems that this method may be the first step for the establishment of a diagnosis in injuries to the cartilage and meniscus.

H. W. HEFKE, M.D.

EXPERIMENTAL STUDIES

Further Study on the Influence of an Aqueous Extract of Suprarenal Cortex on the Growth of Carcinoma, Sarcoma, and Melanoma in Animals. Kanematsu Sugiura. *Am. Jour. Cancer*, April, 1931, XV, 707-724.

This is a long detailed report regarding the effect of injections of suprarenal cortical extract into animals and chickens bearing carcinoma, melanoma, and sarcoma transplants, to which the reader is referred for details.

The author concludes that single or repeated subcutaneous or intramuscular injections of the cortical tissues showed no curative, retarding, or accelerating influence upon the tumor growth. Neither early tumor ulcerations nor prolongation of life were noted in the tumor-bearing animals.

JOHN R. CARTY, M.D.

Radiobiological Studies on Tissue Cultures. Hans Laser. *Strahlentherapie*, 1930, XXXVIII, 391.

The author undertook an extensive study of the sensitivity of normal and malignant cells to radiation by the tissue culture method. The source of radiation was a silver tube, 5 mm.

pregnated eggs were irradiated. It appeared that the injury to the cells was proportional to the roentgen dose. The results were plotted, and they always approached an exponential curve. The sperma seemed to be more sensitive to the roentgen rays than the ova. Irradiation carried out at intervals of five minutes following impregnation showed that the maximum injury takes place immediately after impregnation, decreases slowly, reaches a minimum during the metaphase, and increases again with the anaphase.

ERNST A. POHLE, M.D., Ph.D.

Experimental Cancer Research. William H. Woglom. *Am. Jour. Med. Sci.*, February, 1931, CLXXXI, 157.

The author reviews the advances made in the past thirty years in experimental cancer research, and its possible relation to the cancer problem as applied to the human body.

He finds that in this period a vast amount of material has been collected, many previous theories disproven, and research established on a rather firm and much narrowed basis. A good start has been made on such problems as the chemical nature of a carcinogenic agent in tar, the intensity and duration of irritation required to initiate neoplasia, the relation of age to the development of cancer, etc.

ROE J. MAIER, M.D.

Experiments Concerning the Influence of Short Electric Waves on the Growth of Bacteria. W. Haase and E. Schliephake. *Strahlentherapie*, 1931, XL, 133.

The apparatus used by the authors for the production of electric waves of from 3.5 to 20 meters is briefly described, employing a circuit devised by Esau. They studied the following questions: Are bacteria injured or killed if brought into the condenser field? Does the effect of the condenser field on bacteria run parallel to the temperature? What influence has the wave length? Is it possible to influence infections in animals?

Comparisons of cultures placed in the water bath at equal temperature with those in the electric field showed that the bacteria died quicker in the latter. Therefore, the increased

temperature is not the only cause of death. In some bacteria the results obtained were not uniform. For staphylococcus, waves of 3.5 and 20 meters have an optimal effect; 6-meter waves have little effect. If tuberculosis bacilli were injected into the knee joints of guinea pigs, a definite retardation of the pathologic process was noted if the animals were placed in the condenser field.

Emphasis is laid on the statement that the results reported are only of a preliminary nature. Further studies must be undertaken before the general therapeutic use of these electrical waves can be recommended.

ERNST A. POHLE, M.D., Ph.D.

GALL BLADDER (NORMAL AND PATHOLOGICAL)

The Differential Diagnosis between a Calcified Gall Bladder and Solitary Stone or Cyst. Franz Herz. *Röntgenpraxis*, April 1, 1931, III, 307.

By using different projections, the author shows that the calcified gall bladder may be seen either as a closed circle or as a pear-like structure. This facilitates the differential diagnosis from solitary stone or cyst. In the four cases which are described, the calcification of the gall bladder was not responsible for the symptoms, and one should not overestimate its importance (in two cases a hypernephroma was found).

H. W. HEFKE, M.D.

Simultaneous Roentgenographic Visualization of Gall Bladder and Urinary Organs. B. Varela Fuentes and P. Rubino. *Deutsche med. Wchnschr.*, Feb. 27, 1931, LVII, 364.

In patients with symptoms referring to the right upper quadrant, combined pyelography and cholecystography is often desirable. The authors carried out experiments on dogs and rabbits, and found that uroselectan and tetraiodin may be injected without producing intoxication. In clinical practice, the authors proceed as follows: Three grams of uroselectan are dissolved in 70 c.c. of double distilled water. Three grams of tetragnost (Merck) are dissolved in 30 c.c. of water.

years was 1,151, with 296 deaths. Leitch, in 1923, tried the effect of a Scottish blast-furnace tar on the skin of mice and, although it was continued for eight months, no tumors were produced. Others studying the action of different tars have come to the same conclusion. In view of this evidence, the discovery that an extract of such a tar (Scottish blast-furnace) would lead to tumor development in mice, called for further inquiry.

In the original experiment an ether extract of the blast-furnace tar was used. Twenty-five of the forty-five mice originally subjected to the tarring developed tumors. On histological examination, seven of these were found to be malignant. The fact that an ether extract of the tar was used suggested the possibility that the chemical treatment might have been responsible for this action. The experiment was then repeated with untreated tar on two series of mice, the first of 50, and the second of 100. In the first experiment the mortality was very high, but, in spite of this, five of the animals developed tumors, one of which was a spindle-cell sarcoma, and the other four were simple warts. The sarcoma developed under the treated area of skin. Of the 100 mice, 20 acquired tumors, 2 of which were squamous carcinoma, and 19 simple warts.

The author believes that the only conclusion is that the sample of blast-furnace tar used in these experiments, though not as potent as gas-tar, is definitely capable of inducing tumors in mice. To be sure that there was no difference in the tar used by the author and by other workers, a careful survey of the source of the tar was made, including chemical examination, and it was found to differ in no essentials from tar used by other workers. The author believes that the fact that gas-tar and blast-furnace tar are both carcinogenic, despite the differences in their chemical composition, must be considered of some significance, particularly in relation to the controversy on the "specificity of carcinogenic agents."

So far, no case of skin cancer arising from contact with blast-furnace tar has ever been reported, but even if it be assumed that any agent which is carcinogenic for mice must

necessarily also be carcinogenic for man, it is still not justifiable to presume that the workmen who handle the tar should necessarily develop cancer of the skin, for it is possible that they do not handle the tar frequently enough or for a sufficient length of time for the condition to develop, particularly as blast-furnace tar appears to be less potent than gas-tar. At the same time, it must be realized that regulations dealing with hygienic measures and medical inspection need not be so strict for blast-furnace tar workers as for those who come into contact with gas-tar, pitch, paraffin, and oils. Therefore, it is not unreasonable to imagine that, with more careful medical supervision, cases of cancer, due to blast-furnace tar, may yet be found in those industries in which workmen are liable to come into intimate contact with the tar.

H. J. ULLMANN, M.D.

The Influence of Red and Blue Rays on Growth. Fritz Ludwig and Julius v. Ries. *Strahlentherapie*, 1931, XXXIX, 485.

Rats were kept in cages and exposed to either blue or red radiation; other rats were exposed to daylight filtered through ordinary glass serving as controls. A definite increase of growth was noted in the animals exposed to the red rays alone. It is suggested that the results of this experimental observation might be of use in pediatrics.

ERNST A. POHLE, M.D., Ph.D.

Radiobiologic Experiments on the Germ Cells of the Sea Urchin. H. and M. Langendorff. *Strahlentherapie*, 1931, XL, 97.

The authors studied the effect of one quality of roentgen rays on cells in different stages of mitosis. Ova and sperma of the sea urchin (*Psammechinus miliaris*) were exposed as follows: 180 K.V., 5 ma., 3.0 mm. Al, 10 × 15 cm. field, arranged so as to avoid back-scattering, from 50 to 400 r. The variation in the exposure time was not more than in the ratio of one to two. Sperma was irradiated and used for the impregnation of normal eggs; eggs were irradiated and impregnated with normal sperma; eggs and sperma were irradiated before impregnation, and, lastly, im-

pyloric region was thought to be a leukemic tumor, but proved in the further course of the disease to be carcinomatous. One should not forget that tumors, of the gastro-intestinal tract especially, may show a leukocytosis with myelocytes (Nägeli).

The roentgenologic appearance of two cases of cicatricial constriction of the stomach after ingestion of zinc chloride is described. If a diagnosis can be made from the history, the recognition is easy. If not, it is hard to differentiate it from an infiltrating tumor by the roentgenologic examination alone.

In two cases it is shown that one must be very careful in diagnosing a "malignant relief" from the appearance of the mucosa. Multiple tumor-like filling defects were presented, which, however, changed their appearance on repeated examinations. A normal mucosa was seen shortly afterward (five, respectively, one week later). Only this fact made a diagnosis of gastritis possible.

H. W. HEFKE, M.D.

Serial Radiography of the Pyloro-duodenal Tract: An Apparatus Answering All the Demands of the Technic. R. Herdner. *Arch. d'Électricité Méd.*, March-April, 1930, XXXVIII, 164.

The author describes an apparatus which he has devised and constructed for the purpose of taking roentgenograms of the duodenum and pyloric antrum. These are deep abdominal organs and the shadow of the duodenum is extremely mobile, intermittent, and transitory, necessitating a rapid exposure when the roentgenographic method is used. The above disadvantages are likewise manifested during fluoroscopy, which is especially dangerous to the operator. Because of the relative haziness of the shadow, one is tempted to further increase the penetration, likewise the danger of this method of examination.

In using this apparatus the author claims that much of the hazard is eliminated, for the operator, shielded by a lead barrier, watches for the appearance of the image of the pylorus and duodenum on the fluoroscopic screen, and at this instant, by means of a relatively simple

device, he is able to immediately fix the shadow on a film.

J. N. ANÉ, M.D.

A Case of Leiomyosarcoma of the Stomach. Leon Schiff and Margaret Foulger. *Jour. Am. Med. Assn.*, March 21, 1931, XCVI, 942.

This is a case report of a white man, aged 50, with no previous abdominal pain and no digestive disturbances other than occasional flatulence and eructation of sour material. A firm mass presenting a distinct edge and descending freely on inspiration was felt to extend well below the left costal margin in the mid-clavicular line. It was thought to be an enlarged spleen. The red cells numbered 4,500,000 per cubic millimeter and the hemoglobin was 55 per cent (Dare).

A fluoroscopic examination revealed a large irregular niche in the lesser curvature of the stomach, several inches above the pylorus. This was interpreted as a subacute perforating gastric ulcer, related to the mass thought to be spleen.

Exploratory laparotomy showed a tumor mass in the posterior wall of the stomach, extending upward to the lesser curvature. Incision through the gastrocolic omentum elicited a large amount of foul smelling pus. At necropsy, this proved to be a leiomyosarcoma, involving the lesser curvature and posterior wall, with an ulcer 7 mm. in diameter, which had perforated the posterior wall and communicated with a walled-off abscess cavity in the lesser peritoneal sac.

CHARLES G. SUTHERLAND, M.D.

GASTRO-INTESTINAL TRACT (THERAPY)

The Indispensable Uses of Narcotics in the Treatment of Diseases of the Gastro-intestinal Tract. Robert A. Hatcher. *Jour. Am. Med. Assn.*, May 2, 1931, XCVI, 1475-1477.

Diarrhea is the most common disease of the gastro-intestinal tract for which narcotics are used. An understanding of the physiology and pharmacology of this region is essential for

The uroselectan is injected first in about 15 minutes and immediately after that, with the same needle, the tetraiodin is injected in about 3 minutes. The injection is done at eight o'clock in the morning before the patient has taken any food and after the necessary preparation of the bowels on the preceding day. Films are taken 15 and 45 minutes following the injection. The patient returns in 12 hours and 16 hours for additional films. If roentgenograms are taken 4 hours after the injection, it is possible to make topographical studies of the abdominal organs.

ERNST A. POHLE, M.D., Ph.D.

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

The Rôle of the Pyloric Sphincter in the Behavior of Gastric Acidity. Robert Elman and A. P. Rowlette. *Arch. Surg.*, March, 1931, XXII, 426.

A study of the acid control of the pylorus was made, a theory which was advanced by Cannon in 1907. The authors state that acid on the stomach side opened the pylorus, and on the duodenal side closed it.

From these studies they recommend the conception of the pyloric control of gastric acidity rather than that of unqualified acid control of the pylorus. They also discuss the clinical implications from this theory.

HOWARD P. DOUB, M.D.

Foreign Bodies in the Gastro-intestinal Tract of Psychotic Patients. Henry J. Kelum. *United States Vet. Bureau Med. Bull.*, January, 1931, VII, 50.

The author reports the case of a patient with dementia præcox of the catatonic type, who, on several occasions, attempted suicide. After hospitalization he developed many gastric attacks and it was discovered each time that these resulted from the ingestion of foreign bodies of all varieties. In the final attack it was believed that all had passed, with the exception of a nail, the shadow of which was seen on the roentgenogram. Laparotomy revealed numerous pus pockets, with adhesions,

but no foreign bodies. The patient subsequently developed empyema and died.

Postmortem examination of the abdomen showed a mass of adherent intestine, which could not be separated. In this mass was found the nail and several other foreign bodies which were not opaque to the X-rays. In this case, a localized peritonitis had resulted which was followed by thrombosis and embolism. These, in turn, were followed by pulmonary infarction, with pyo-pneumothorax.

The author does not believe it possible to base prognoses on the size, shape, and number of foreign bodies. Medical treatment of an expectant nature should be tried first and surgery resorted to only when definite indications arise.

J. N. ANÉ, M.D.

The Roentgenologic Appearance of Rare Diseases of the Stomach. Kurt Kremser. *Röntgenpraxis*, April 1, 1931, III, 289.

Several cases of rare diseases of the stomach are described. The first case is that of a lymphosarcoma of the stomach, which presented itself as a large irregular filling defect on the greater curvature. Roentgenotherapy greatly reduced the size of the spleen, which was very large before treatment, but did not seem to influence the tumor of the stomach. An autopsy confirmed the diagnosis.

Two cases of gastric syphilis are described. In one case the microscopic examination of the resected pylorus gave the typical appearance of a syphilitic process. The roentgenologic appearance was that of a pyloric malignancy. Another case showed a consistent hourglass-like contraction in the median part. It is conceded by all authors that a definite differential diagnosis between sarcoma, lymphogranuloma, syphilis, or tuberculosis of the stomach from a carcinoma cannot be made roentgenologically.

Leukemic infiltration of the gastric mucosa is described. There were many oval and fairly well circumscribed small defects visible on roentgenologic examination. In another case the blood picture indicated a myelogenic leukemia. An irregular filling defect in the

pyloric region was thought to be a leukemic tumor, but proved in the further course of the disease to be carcinomatous. One should not forget that tumors, of the gastro-intestinal tract especially, may show a leukocytosis with myelocytes (Nägel).

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CHARLES G. SUTHERLAND, M.D.

GASTRO-INTESTINAL TRACT (THERAPY)

The Indispensable Uses of Narcotics in the Treatment of Diseases of the Gastro-intestinal Tract. Robert A. Hatcher. *Jour. Am. Med. Assn.*, May 2, 1931, XCVI, 1475-1477.

Diarrhea is the most common disease of the gastro-intestinal tract for which narcotics are used. An understanding of the physiology and pharmacology of this region is essential for

the treatment of diarrhea. The diet exerts a profound influence on the entire digestive tract. The rôles of the sympathetic, the vagus, and the plexuses of Auerbach and Meissner in the normal gastro-intestinal tract are not known. Diarrhea results from exaggerated normal peristalsis, frequently with excessive secretion; hence the necessity of discussing the normal movements of the gastro-intestinal tract. For children, the official chalk mixture or lime water is recommended. Papaverine is less certain and prompt than morphine. Codeine has comparatively little influence in the intestinal peristalsis.

Because the common causes of diarrhea and the methods of treating it differ in many ways in infants and in adults, these are considered separately.

Treatment is divided into "correction of causes" and "drugs." Patients should be trained to observe any disturbing effect of various foods. Enemas are preferred to cathartics for dry, hard, impacted feces. Hydrochloric acid is an extraordinarily active antiseptic. Castor oil is a mild non-irritating laxative, useful in children and adults. Potassium and sodium tartrate or magnesium sulphate is equally effective. The early administration of morphine or opium may do incalculable harm. Bismuth subcarbonate is preferable to the subnitrate. Tannic acid in the form of gambir or acetyltannic acid is useful. Hypnotics of the barbital type allay nervousness and frequently diminish intestinal peristalsis.

CHARLES G. SUTHERLAND, M.D.

Roentgen Therapy of Gastric and Duodenal Ulcers. A. Groszlik. *Strahlentherapie*, 1931, XL, 286.

Twenty cases of ulcer of the stomach and 11 cases of ulcer of the duodenum were treated by roentgen rays (180 K.V., 0.5 Zn or Cu + 4.0 Al, from 75 to 100 per cent erythema surface dose, distributed over from 5 to 7 days; 1 large anterior and posterior field). One series was given in 12 cases, 2 series in 8 cases, and 3 series in 11 cases. The intervals between the series were from one to several months. Nausea followed the treat-

ment in 14 patients, 4 developed rather severe X-ray sickness, and 5 could not be traced. The remaining 26 were observed for from 3 months (11) up to 6 and 12 months (15). The most striking result was the relief from pain. It disappeared completely in 5 out of the 11 cases; 3 had less pain but it returned after meals, and 2 obtained temporary relief. Four out of the 15 cases had no pain during the entire period of observation. In 9, it disappeared for several months but returned within a year. In 2, there was only a slight improvement, and one case developed a recurrence which necessitated operation after six months. The relief from pain did not begin immediately after the first treatment, but took from several days to as many weeks before the effect became noticeable. Other symptoms as, for instance, flatulence, constipation, bleeding, lack of appetite, nausea, and vomiting were often favorably influenced before the pain decreased.

The paper concludes with a discussion of the possible mechanism of the effects of roentgen rays on gastric and duodenal ulcers.

ERNST A. POHLE, M.D., Ph.D.

A Case of Pyloric Obstruction Responding to Medical Treatment. Walter de M. Scliver. *Canadian Med. Assn. Jour.*, January, 1931, XXIV, 99.

This is a case report of a patient, a male, 73 years of age, who, up to the middle of April, 1930, had enjoyed good health. At that time he first noticed a dull pain in his upper abdomen, associated with constipation and anorexia. Three weeks later he commenced to vomit, at first at intervals of one or two days, large amounts of coffee-ground material, which came up suddenly, with very little associated nausea. Later the vomiting became more frequent, usually an hour or two after meals, with relief of the pain. The loss of weight was marked, and his strength failed rapidly.

A barium examination was reported as follows: "After six hours, about 50 per cent of the meal remains in the stomach—the rest lies in the ileum. The stomach is large, J-shaped, is seen to contain fluid, and has no irregu-

larities. Good peristalsis, but no cap forms. Twenty-four hours later, about 50 per cent of the meal remains in the stomach."

An X-ray diagnosis was made of "pyloric stenosis, caused probably by a duodenal ulcer, and giving rise to at least twenty-four-hour retention."

On account of his age and poor physical condition, operation was not advised. The stomach was washed out twice daily, and intravenous injections of 400 c.c. of 20 per cent glucose in normal saline, followed by 100 c.c. of normal saline, were given morning and night. In addition, on the third day, feedings of 250 c.c. of orange juice, eggnog, or milk, in rotation, were given every three hours during the day. For some time there was no change in the gastric retention, but, as he refused operation, the treatment was continued, gradually increasing the feedings. With the morning gastric residue at 600 c.c. the patient was sent home with instructions to follow the same diet and wash out the stomach each morning before taking food. He was observed at frequent intervals, and as the gastric residue gradually reduced, the feedings were increased. In six months' time, the gastric morning residue completely disappeared, and the lavages reduced to one a week. The patient feels much better, has gained thirty pounds in weight, and attends to his usual business. A recent X-ray examination showed the stomach empty at six hours. The stomach was normal in size and tone, and a normal duodenal cap was seen.

This extremely interesting case is from the Department of Medicine, McGill University Clinic, Royal Victoria Hospital, Montreal.

L. J. CARTER, M.D.

GENITO-URINARY TRACT (THERAPY)

Diathermy in Nephritis. W. Ewig. *Deutsche med. Wchnschr.*, Jan. 9, 1931, LVII, 51.

Following an analysis of the effect of diathermy on the kidney function, and the report of two cases of acute nephritis that had been benefited by diathermy, the author pre-

sents the following conclusions: Diathermy of the normal kidney leads to an increased diuresis; acute glomerular nephritis is influenced materially by intense diathermy to the kidneys; eclamptic conditions usually disappear without any other therapeutic measures, if diathermy is given to the kidneys and to the head. In sub-chronic and chronic nephritis, the results are questionable. The cerebral symptoms of kidney insufficiency are influenced favorably by diathermy applied to the head.

ERNST A. POHLE, M.D., Ph.D.

Treatment of the Insufficient Kidney by Thyroid Extract and Roentgenotherapy. A. Hermann Müller. *Deutsche med. Wchnschr.*, Feb. 6, 1931, LVII, 230.

In two cases of uremia, due to arteriosclerotic kidney disease and to sub-chronic glomerular nephritis, the author obtained considerable improvement following the administration of thyroid extract and X-ray therapy to the kidneys. The technic was as follows: 170 K.V., 4 ma., 30 cm. F.S.D., 8×10 sq. cm. field, 0.5 mm. copper plus 1.0 mm. aluminum, 70 per cent E.D. The effect of this treatment on the diuresis, the disappearance of albumin from the urine, and the drop of the blood pressure were particularly striking.

ERNST A. POHLE, M.D., Ph.D.

GRENZ RAYS

Grenz-ray Therapy in Skin Diseases. Franz Blumenthal and Lothar Böhmer. *Deutsche med. Wchnschr.*, March 6, 1931, LVII, 404.

In Grenz-ray therapy, the exact measurement of the quality and quantity of radiation is of prime importance; besides this, the correlation of the physical dose with the biologic effect must be established. The authors believe that the safest method is to determine the threshold erythema, since marked pigmentation remains for a long time following high doses. In view of the fact that severe erythema reactions have been observed even in institutions where the dose is carefully controlled by ionization measurements, the general

use of these long wave lengths of roentgen rays can not be advocated. In their own clinic, the authors have applied from 400 to 500 r at from 9 to 10 K.V., 10 ma., 12 cm. F.S.D., at intervals of from one to two weeks, up to three times per area.

A comparison of the results obtained in a number of skin diseases with those following ordinary roentgen therapy revealed the fact that there existed apparently no difference in the results, except for a somewhat slower action of the Grenz rays. The general body exposure did not lead to different results in the authors' experience than those obtained by ultra-violet irradiation.

ERNST A. POHLE, M.D., Ph.D.

Therapy with Long Wave Length X-rays (Grenz Rays). Francis Carter Wood and George M. MacKee. *Jour. Am. Med. Assn.*, Jan. 10, 1931, XCVI, 111 (Reprinted in "Radiology," May, 1931, XVI, 697).

It has long been known that the commercial X-ray tube emits practically no X-rays when run at a voltage of 10 kilovolts or less. The reason for this is the high absorptive power for the long wave length rays of the glass from which tubes are made. Lindemann showed that if a lithium borate glass was used, and the thickness kept low, X-rays of considerably longer wave length would escape from the tube than if ordinary glass were used.

The special tube which is most popular for this purpose is a small, water-cooled, unipolar, hot-cathode glass tube which, with the exception of the Lindemann glass window, is encased in a metal housing. The tube is delicate and its life is likely to be short. It is important not to touch the Lindemann glass window.

The biologic effects, apparatus, tube, and cutaneous reactions are described and discussed.

The best field for Grenz-ray therapy is in dermatology. While the radiation is a valuable therapeutic agent, it is less efficacious, less versatile, and more time-consuming than X-rays of shorter wave length. In spite of the higher degree of safety, the method is not yet

suitable for use by others than those who have been adequately trained in X-ray work.

It is especially suitable when it is necessary to avoid temporary or permanent injury to important organs and to glandular apparatus in or under the true skin, such as hair roots, sebaceous and sweat glands, testes, and the eyes. The method is comparatively safe and very useful for patches of various dermatoses located on the scrotum, eyelids, and scalp—eczema, psoriasis, lichen planus, lupus vulgaris, and basal-cell epithelioma.

Good results for the indirect Grenz-ray treatment are claimed for gastric ulcer, gastric hyperacidity, Banti's disease, polycythemia rubra, hypothyroidism, dysmenorrhea, oligomenorrhea, amenorrhea, hypertrichosis, asthenia, arthritis deformans, asthma, pertussis, angina pectoris, and spastic constipation. Indirect treatment was used successfully in a number of skin diseases such as acne vulgaris, acne rosacea, universal erythroderma, and urticaria. The effect on acne rosacea is said to be especially good. Exophthalmic goiter, Hodgkin's disease, and leukemia are not favorably influenced. The results of indirect Grenz-ray treatment have not yet been corroborated to any extent, and only a few cases of each disease have been reported.

A comprehensive bibliography is appended, as "suggested references for future reading."

CHARLES G. SUTHERLAND, M.D.

The Treatment of Lupus Vulgaris with Grenz Rays. B. Spiethoff. *Strahlentherapie*, 1931, XL, 245.

The author has obtained excellent results with borderline rays, in the treatment of lupus vulgaris. He applied rather high doses, namely, from 4,600 to 25,000 r in one sitting (9 K.V., 10 ma., 2.5 cm. F.S.D.). At 2½ cm. distance the diameter of the exposed area is about 3 centimeters. The total cost of the treatment was usually very reasonable. This is an important economical factor. Lower doses (1,150 to 2,300 r) are indicated if the active lesion lies in an atrophic area. The exact procedure must be adapted to the particular needs of each case.

A number of photographs showing patients before and after treatment are appended.

ERNST A. POHLE, M.D., Ph.D.

GYNECOLOGY AND OBSTETRICS

The Diagnostic Value of Radiology in Obstetric Practice. Noel Hypher. *British Jour. Radiol.*, April, 1931, IV, 171.

This article deals with the roentgenologic studies made on 105 selected cases from 18,000 routine obstetric cases passing through the Antenatal Department of Queen Charlotte's Hospital. The author considers antenatal radiographic examination as a definite additional diagnostic method of value in reducing both the maternal and fetal mortality rate.

With films of good technical quality, beginning ossification of the head and spine should be demonstrable consistently after the sixteenth week. Methods of lipiodol injection into the uterus, pneumoperitoneum, etc., for earlier diagnosis, may contribute supportive evidence to the presumptive diagnosis of pregnancy, but the findings are, of course, not pathognomonic.

Ovarian cyst, complicating or simulating pregnancy, may be recognized by showing the fetus pushed to one side, and a large homogeneous shadow occupying the remainder of the abdomen.

Disproportions of the presenting part to the pelvic inlet and internal pelvic measurements may be made. In the latter procedure, the author uses an ordinary metal pelvimeter, applied to the spine of the fifth lumbar vertebra and symphysis pubis, in order to get the inlet parallel to the film. To determine the actual diameter from the film measurements, he utilizes this factor of correction:

$$\frac{(\text{Tube distance from film}) - (\text{Distance of fifth lumbar spine})}{(\text{Tube distance from film})}$$

Pelvic bone deformities in the nature of bony tumors or kyphotic or rachitic pelvis can likewise be shown radiographically.

The demonstration of the ossified epiphyseal center at the lower end of the femur is considered the best X-ray evidence of the fetus being at term. Complicated presentations (more often in multiple pregnancy) and fetal abnormalities (anencephaly, hydrocephaly),

etc., are usually clearly demonstrable at a definite interval before term.

The roentgenograms accompanying the article are of unusually good quality.

J. E. HABBE, M.D.

Roentgenologic Diagnosis of a Quadruplet Pregnancy. G. J. Pfalz. *Röntgenpraxis*, April 1, 1931, III, 328.

The diagnostic value of a roentgenologic examination in anomalies of the later pregnancy has been definitely established. The film is the first one, to the author's knowledge, to show quadruplets. Repeated roentgenograms were made during the delivery, and were of value for the prognosis and treatment.

H. W. HEFKE, M.D.

Birth of a Living Child after Irradiation of Carcinoma of the Portio. E. Philipp. *Ztschr. f. Geburtsh. u. Gynäk.*, Dec. 30, 1930, XCIX, 179.

The author gives a detailed report of a case in which a living, normal child was born to a V-para, aged 45, three years after radium irradiation of the portio for carcinoma, which resulted, three months after treatment, in abortion of a pregnancy existing at the time. Examination three years after the birth of the child showed severe shrivelling of the portio and shortening of the vaginal arch, with the uterus small and anteфлекed. According to the woman's own statement, the delivery required a slightly longer time than was the case in earlier labors, but was accomplished without artificial aid.

In his comment on the case, the author makes the statement that radium offers the only possibility for treating carcinoma without destroying the function of the uterus and the ovaries.

X-rays in the Diagnosis of Pregnancy: Are They Injurious to Fetus or Ovary? L. H. Garland. *California and Western Med.*, March, 1931, XXXIV, 150.

The author endeavors to show that from the third month on, with good technic, the

fetal shadows should show on the X-ray film. They will be faint, except in perfect films, and show the spine as a row of beads and the occiput as a crescent; later the thin lines of the rib cage are shown. The oblique position is often helpful when the parts are small and overlies the sacrum. In the experience of the author, the spine and occiput have been demonstrated after the twelfth week. After the fourth month, with good technic, a positive diagnosis should be made without exception, unless the patient is excessively stout.

He also discusses the question of injurious effect of irradiation of the fetus *in utero* and can find no report of a single injury to the mother or fetus when the X-rays have been used for purely diagnostic purposes. Again he makes the assertion that the X-ray demonstration is the earliest positive proof of pregnancy.

F. B. SHELDON, M.D.

Physical Methods of Treatment in Gynecology. Friedrich Voltz. *Therap. d. Gegenw.*, January, 1931, LXXII, 29-34.

In this article the author reports the results of X-ray treatment of carcinoma of the female genital organs in the Döderlein Institute in Munich. During the ten-year period from 1913 to 1923, a total of 1,319 cases of carcinoma of the cervix were treated with X-ray therapy. Of this number, 222 were free from recurrence at the end of a five-year period, making a recovery percentage of 15.4. It should be noted that the 1,319 cases included the incurable ones and those with bad prognosis. During the period from 1923 to 1925, an additional group of 171 cases was treated. Among these were 40 cases free from recurrence at the end of the five-year period, a recovery percentage of 23.3. The improvement over the earlier group the author attributes to improved methods of treatment.

Divided into groups, according to the classification of Döderlein, the recovery statistics were as follows:

Group I, operable cases.....	41 per cent
Group II, borderline cases.....	23 per cent
Group III, inoperable cases.....	11 per cent
Group IV, incurable cases.....	4 cases

Similar results were obtained in the other genital carcinomas; the statistics for body of the uterus were as follows:

Total material	41 per cent
Operable cases	66 per cent
Recurrent cases	10 per cent

For carcinoma of the vagina and vulva, the recovery percentages were 5 and 12 per cent, respectively.

The author compares these statistics with the averages obtained from the figures given in the literature which he found to be as follows:

Carcinoma of the cervix (percentage of all cases)	17.4 per cent
Carcinoma of the cervix (operable and borderline)	42.7 per cent
Carcinoma of the body of uterus (percentage of all cases).....	35.6 per cent
Carcinoma of the body of uterus (operable cases)	56.5 per cent

In the remainder of the article the author discusses the use of X-ray therapy in temporary sterilization, menorrhagia, and metropathia. There is also a discussion of light treatment, with the various types of lamps, and of electrotherapy.

The Gynecologic Measurement of the Pelvis by Means of the Roentgen Rays. Walter Schaefer. *Röntgenpraxis*, Feb. 1, 1931, III, 97.

The rather extensive literature on the subject of pelvic measurement by means of the X-ray is reviewed. The technical difficulties and the routine, as followed by the author, are described in detail. The conclusions reached by the author state that it is possible to get correct measurements of the pelvis. It is, however, not yet possible to measure the head of the fetus with any amount of certainty. The relationship of the size of the fetal head and the bony pelvis is the most important factor for the obstetrician, and the roentgenologic examination has not yet achieved success in this particular question. In spite of it, the measurement of the pelvis by means of the X-ray, which is correct if proper technic is used, has been of valuable help in many cases.

H. W. HEFKE, M.D.

The Three-field Method of Castration and its Value. W. Dietrich. *Röntgenpraxis*, Feb. 15, 1931, III, 186.

Holfelder's three-field method of castration is highly recommended by the author as a further improvement over other technics. One hundred fifty patients have been treated in this way. An application of 270 r over the uterus and ovaries is successful in all patients between the ages of 35 and 40, and the nearer the climacteric, the smaller the dose. There is no question but that irradiation therapy is superior to surgery in most cases. The surgical mortality is still about 3.5 per cent, while a statistical survey of 11,341 irradiated cases showed a mortality of only 0.18 per cent. Compared with other methods (Seitz and Wintz, Gauss, Bécclère, Fürst), the one of Holfelder has the advantage of the most homogeneous distribution of the rays, the greatest safety, and the shortest time of application.

H. W. HEFKE, M.D.

LIGHT THERAPY

Effect of Light on Bacteria. O. Winterstein. *Strahlentherapie*, 1931, XXXIX, 619.

In the study of the bactericidal effect of light, one must differentiate between the effect on bacteria in cultures and bacteria in their natural surroundings. Experiments as to the bactericidal action of ultra-violet rays from a quartz mercury vapor lamp led the author to the following conclusion: It is possible very easily to kill bacteria which settle down on the floor or on the surface of objects. Bacteria suspended in air can be decreased in number by ultra-violet light. Garden soil could not be sterilized by an exposure of one hour. Irradiation of the human skin with ultra-violet light reduced the number of bacteria considerably. In infected wounds in human beings even high doses did not kill all bacteria. This procedure has, therefore, no great practical value. Dried pus exposed for one hour became sterile. If the layer of pus was made a few millimeters thick, pneumococci and streptococci were not killed. Silk

used for surgical sutures which had been contaminated with staphylococci, streptococci, and coli could not be sterilized by an exposure of one hour at 75 cm. distance.

An extensive bibliography (over 4 pages, small print) is appended.

ERNST A. POHLE, M.D., Ph.D.

Concerning Ways and Means to Shorten Heliotherapy and Make It More Effective. Charles Brody. *Strahlentherapie*, 1931, XXXIX, 764.

Analysis of the present methods of light therapy and six years' experience in a great number of cases led the author to the conclusion that usually the dose applied in heliotherapy is too high. A temporary improvement is often nullified because the treatment has been carried on without interruption and continued for too long a time. The pigmentation and the lowered susceptibility hinder any further progress in healing. Pigmentation alone is no indication for the prognosis. As a number of case reports show, a pigmentation produced too quickly may lead to undesirable results. It is necessary to reduce the single dose and interrupt the treatments at certain intervals. After de-pigmentation has been brought about, a new series of treatments may be started, and a favorable reaction expected. The author combines heliotherapy with exposure to the mercury vapor lamp and a carbon arc lamp. The technic is given in detail.

In conclusion, it is emphasized that daily sun treatments of from three to six hours are too long—they should not exceed one hour. By inserting intervals to permit recovery of the skin, the total duration of the treatment can be shortened considerably.

ERNST A. POHLE, M.D., Ph.D.

Our Knowledge of the Quartz Mercury Vapor Lamp. V. Wucherpfennig. *Strahlentherapie*, 1931, XXXIX, 663.

The author conducted a number of tests with a quartz mercury vapor lamp. He confirmed the findings of other observers as to the closing and opening of the hood: opening leads to a drop in the potential and closing to

an increase. This may be explained by a change in the temperature surrounding the burner. The output is not directly related to the watt input, but depends upon the potential across the arc. In other words, the same product of volt, times amperes, leads to different intensities in the emission if the volt factor varies. A drop in the potential cannot be counterbalanced by a rise in the current. One test showed the following relations: lamp burned at 135 volts, 2.5 amperes equaling 338 watts; erythema time 3.15 minutes. At 96 volts, 3.75 amperes, also equaling 338 watts, the output dropped to 25 per cent. It is suggested, therefore, that a rheostat be placed in the current for balancing line fluctuations of plus or minus 10 per cent, and check it by a voltmeter. A thermostat in the hood could serve as control for the burner current. Graduation in degrees or in arbitrary units also seems advisable.

ERNST A. POHLE, M.D., Ph.D.

Remarks Concerning Various Sources of Artificial Light in Practice. A. Laqueur. *Strahlentherapie*, 1931, XXXIX, 643.

This is a brief discussion of the relative merits of a number of lamps available on the German market, with particular emphasis on the practical viewpoint.

ERNST A. POHLE, M.D., Ph.D.

A Method for the Absolute Measurement of the Erythema-producing Rays of the Quartz Mercury Vapor Lamp. O. Gaertner and G. Klovekorn. *Strahlentherapie*, 1931, XL, 383.

A measuring method for the radiation of the quartz mercury vapor lamp below 3,600 Å. has been worked out by the authors. It is based on the fact that silver barely reflects radiation below 3,600 Å. and is, therefore, easily heated by the shorter wave lengths. A small silver strip is placed over the joints of the thermocouple. For measuring the total output, a blackened manganin strip was used. The results with this arrangement were fairly satisfactory.

ERNST A. POHLE, M.D., Ph.D.

The Transparency of the Human Skin in the Region of 0.3-2.0 Micron. O. Gaertner. *Strahlentherapie*, 1931, XL, 377.

The author studied the transparency of the human skin for different wave lengths. A nitra lamp and a quartz mercury vapor lamp, in connection with a monochromator and thermocouples, were used. It appeared that in the region of 1.5 to 0.7 micron, the skin is most transparent and there is very little dependence of the wave length. Above 1.5 micron the transparency drops, showing the greatest individual differences in the violet and ultra-violet. Very little variation was found in the examined cases between 1.5 and 0.7 micron.

ERNST A. POHLE, M.D., Ph.D.

The Protective Function of the Skin against Light Rays. G. Miescher. *Strahlentherapie*, 1931, XXXIX, 601.

The author discusses the literature dealing with the protective properties of the skin against over-exposure to light. For a long time it was believed that the pigmentation was Nature's screen against ultra-violet rays. Experiments of his own convinced the author, however, that the thickness of the epithelium is, in all probability, the most important factor. This does not mean, of course, that the pigmentation is without any influence, particularly if it appears in the upper layers of the skin. Little is known as to the biologic effect of other spectral ranges. It may be assumed, though, that hyperemia and sweating are the reactions of the skin to prevent over-heating following exposure to red and infra-red light.

ERNST A. POHLE, M.D., Ph.D.

The Problem of Dosage in Heliotherapy of the Inner Organs. P. Roussel. *Strahlentherapie*, 1931, XXXIX, 787.

The dosage in heliotherapy depends on many factors; the most important are the clinical form of the disease, the individual susceptibility of the patient, and the intensity of the sunlight available. A fundamental rule is to interrupt the exposure if the patient shows fatigue. The treatment schedule is subdivided into three groups: patients whose treatment can be prolonged by five minutes

per day, by ten minutes per day, and by fifteen minutes per day. In the first group, only the lower legs are exposed, then are added the thighs; after about a month the abdomen, and lastly the thorax. This schedule must, of course, be modified in each case by the attending physician, based on clinical observations of the patient.

ERNST A. POHLE, M.D., Ph.D.

Stimulating Irradiation with Quartz Lamp in Constipation. Maximilian Grünsfeld. *Ztschr. f. d. ges. physik. Ther.*, Nov. 24, 1930, XL, 28-30.

The author reports his results in 15 cases of constipation treated with quartz lamp irradiation. Two cases failed to respond but the other 13 showed decided improvement; in some the recovery was permanent and in others repeated irradiation was done with good results. In irradiation the author used burners with a constant current voltage of 220. The distance was chosen according to the sensitivity of the patient but irradiation was done in such a way as to induce a pronounced light erythema. The average distance was between 50 and 70 cm., and the time of exposure to the rays varied from 10 to 20 minutes. In some cases one irradiation was sufficient; in those in which repetition was necessary it was not done until all of the symptoms of irritation had disappeared completely.

Supersensitivity and Desensitivity to Light in the Origin and Treatment of Neoplasms: Study of an Actinic Theory of Cancer. R. Grynkrant. *Arch. d'Électricité Méd.*, March-April, 1930, XXXVIII, 173.

In this discussion of the relationship of various factors in the origin and treatment of cancer, the author considers that the actinic theory does not oppose other views, for, being of a more general nature, it rather unites, classifies, and explains them.

It is believed that cellular division emits a light which has been found by Reiter and Gabor to lie in the ultra-violet spectrum, with a wave length of 340μ . Muscles during contraction, according to Siebert, Frank, and Popoff, and the circulating blood during oxida-

tion, as shown by Gurvitsch, act as sources of this light, which Gurvitsch described as "mitogenetic," for it was believed to influence the division of the nucleus of the resting cell. The circulating blood also contains potassium, which is radio-active. Zwaardemacker and Feenstra, after maintaining cardiac contractions in Ringer's solution, were able to replace the potassium by roentgen rays of 2,000 volts, and by cathode rays.

The author believes that the two factors which act together on the nucleus of the cell are the light agent and its sensitizer. This action is greater on the cell during division than when at rest. It was further observed that the effect of this light on a sensitive object was cumulative, as a feeble actinic agent which acted over a long period of time produced the same effects as one of greater intensity. Parthenogenesis has resulted from the application of very small quantities of radium to the eggs of sea-urchins and tritons. Since the egg was a cell sensitized to these agents, nuclear division resulted. This sensitivity, in which the effect of the agent was augmented by a better adaptation of the nucleus of the cell to the light wave, is discussed by the author as resonance. It follows, therefore, that a sensitized nucleus, receiving a series of shocks, will be stimulated to accelerated nuclear division. As the acceleration is increased, the nucleus and the cell will become less perfect, and finally a precancerous or a cancerous cell will result.

The sensitizing agents may be endogenous or exogenous. The organs of internal secretion act as endogenous sensitizers. The thyroid was found to accelerate cell division, while the thymus retarded this activity. Smoke, resulting from the burning of coal or oil, is an exogenous sensitizer. For this reason, the incidence of carcinoma is greater in industrial districts.

That this sensitivity to mitogenetic light may have an infectious origin, was shown by Lacassagne, who was able to produce sarcoma in rabbits by inoculation with *B. caviae* and subsequent roentgen irradiation. According to the author, it is possible to think of this

sensitivity as approaching anaphylaxis, because magnesium has been found by Delbet to prevent the appearance of cancer. Magnesium, likewise, inhibits the anaphylactic state and may, therefore, be considered a desensitizing agent.

In the treatment of neoplasms, when radiotherapy is applied to a tumor which is sensitive to this form of therapy, there is produced in the deep tissues a radiation, the wave length of which is in resonance with the nuclear cancer-producing sensitizer. This is followed by an acceleration of its rate of division which is incompatible with its life. Another method of producing this supersensitization is the intravenous injection of diluted alcohol, as suggested by Thursz. This increases the combustion and, therefore, the mitogenetic radiation in the blood.

J. N. ANÉ, M.D.

Skin Studies and Clinical Results of the Application of Visible Cold Red Light. H. Cramer and G. Fechner. *Strahlentherapie*, 1931, XXXIX, 474.

The authors have studied cold red light therapy for several years and believe that it should be used much more in practice. The skin does not show any changes following exposure to this type of radiation. The irradiated skin was studied with the capillary microscope, histologically, and also in connection with histamin and adrenalin injections. The ultra-violet erythema was also used for comparison. The authors believe that visible cold red light is hardly absorbed in the skin but becomes effective in the depths. It differs considerably, then, from the visible heat rays. The clinical results can probably be explained by a non-specific stimulation. Emphasis is laid upon the statement that all cases exposed to this type of light must be treated according to the general medical rules applicable in each respective disease.

ERNST A. POHLE, M.D., Ph.D.

Contribution to the Increase of the Light Erythema by Green Soap. H. Proft. *Strahlentherapie*, 1931, XL, 351.

The application of green soap to the skin

before exposure to ultra-violet light enhances the erythema. The author attempted to find the cause for this effect. It appeared that the increase in the erythema cannot be explained by the presence of a sensitizing dye as, for instance, chlorophyll, nor with a simple swelling of the upper epithelium. Soaking in water and rubbing the skin with cotton slightly increased the erythema. The presence of free alkali appeared to be the most important factor in the enhancing effect. The erythema was decreased by oils and fatty substances. An absolute protection towards ultra-violet light is given by a 10 per cent salicylate alcohol solution. If the upper epithelial layer of the skin of the forearm is removed by shaving and then treated by 0.5 per cent potassium or sodium hydroxid, a spontaneous erythema appears, followed by petechia. Erythema and pigmentation do not run parallel. It is assumed that not only a shifting in the pH is responsible for the increase in the erythema but that an important factor is the influence of alkali-albumin compounds under the influence of the ultra-violet light.

ERNST A. POHLE, M.D., Ph.D.

MIKULICZ'S DISEASE (THERAPY)

Mikulicz's Disease and the Mikulicz Syndrome: Their Treatment by Irradiation. T. Leucutia and A. E. Price. *Am. Jour. Roentgenol. and Rad. Ther.*, November, 1930, XXIV, 491.

On the basis of a study of nine cases, the authors believe with other writers, that "the symmetrical enlargements of the lacrymal and one or more pair of the salivary glands," originally described as Mikulicz's disease, should be divided into two main groups: Mikulicz's disease proper and the Mikulicz syndrome. Under Mikulicz's disease proper are included all cases of symmetrical, non-inflammatory swellings of the lacrymal and salivary glands without involvement of the lymphatic system and without alteration of the blood. Under the Mikulicz syndrome are included the cases in which the enlargements of the lacrymal and salivary glands are manifestations of some clinically and pathologically well-defined disease, such as leukemia, tuberculosis, syphilis,

lymphosarcoma. Hodgkin's disease, uveoparotid fever, etc. In the first group, divided doses of irradiation (15 to 50 per cent S.U.D.) are spread over a longer period. This method of treatment has proven more beneficial than the single massive dose as administered in neoplastic processes. In the second group, since the involvement of the lacrymal and salivary glands is merely a manifestation of a more or less distinct clinical entity, a technic should be used which conforms to the routine procedure of irradiation applied in that particular entity. Mikulicz's disease should not be considered an "aleukemic stage" of leukemia, since the average duration of life is longer in Mikulicz's disease, but the disease is somewhat more resistant to irradiation because of the organized structural arrangement of the enlarged glands.

J. E. HABBE, M.D.

RADIUM

A Hypertrophic Response to Radium Irradiation: A Preliminary Communication. Daphne L. Goulston. *Med. Jour. Australia*, March 21, 1931, I, 335.

The chorio-allantoic membrane of a ten-day chick embryo was exposed by making a window in the shell, according to Moppett's method described in a previous abstract. This membrane has the three embryonic cell layers, ectoderm, mesoderm, and endoderm, conveniently growing together, so that reactions to radiation on each of these embryonic structures may be observed simultaneously.

Radium tubes with active lengths of 1 cm., with 0.5 mm. gold-platinum or 0.5 mm. platinum filter, containing from 2 to 5 mg. of radium element, were laid across the window without actually touching the membrane. After irradiation from 2 to 5 hours and subsequent incubation for three days, macroscopical examination of the membrane revealed irregular thickenings. Microscopically, specimens which received sufficient irradiation showed marked hypertrophy of the mesenchyme. With larger doses, the hemopoietic foci were seen to be in an active state of division, and considerable multiplication of the

ectodermal epithelium was evident. Still larger doses produced changes in all three embryonic layers, while, in addition, the proliferating endodermal epithelium formed a papillomatous growth.

Striking photographs of these appearances are reproduced. The miniature cauliflower tumors formed would seem to afford undoubted evidence of a hypertrophic reaction to radiation, and, therefore, of a stimulating effect of the rays.

J. G. STEPHENS, M.D.

Laryngeal Malignant Disease and Radium. F. Holt Diggle and E. S. Burt Hamilton. *Jour. Laryngol. and Otol.*, January, 1931, XLVI, 37.

Four cases of laryngeal malignant disease treated by radium, with fenestration of the thyroid cartilage, are reported. The early effects of the treatment were very encouraging but there was recurrence in each case. Radium emanation was administered, and, to allow for the loss of potency, a greater initial dose was used. The authors ask whether this dose was excessive, too large and spread over too short a period, or if the treatment by emanation is quite unsuitable in these cases. It is apparent, in any event, that the closest co-operation between the laryngologist and the allied scientists is necessary if progress and not unearned disrepute is to be achieved.

Exposure of Tissue Cells *in Vitro* to Mesothorium. Albert Fischer. *Strahlentherapie*, 1931, XL, 54.

This extensive research was undertaken in order to study the phenomenon of the "latent period" observed following exposure to roentgen or radium rays. The experiments were conducted on tissue cultures of osteoblasts and fibroblasts of the chicken heart. The technic corresponded to that described by Hans Laser and Ludwig Halberstaedter (*Zeitschrift für Krebsforschung*, June 7, 1929, XXIX, 411). The results are expressed in numerous graphs.

It is concluded that the effect of radium on tissue cells *in vitro* manifests itself by an inhibition in growth. This appears only after

at a certain time following the exposure. An analysis of the factors responsible for the latent time shows that the inhibition in growth is partly due to the formation of toxic substances following tissue necrosis. Irradiated tissue cells liberate substances inhibiting the growth of normal cells. The duration of the latent time does not vary much; it is dependent upon the intensity of the irradiation. Injured cells have a shorter latent time. Mitosis does not influence the latent time and the absolute effect of radiation was the same whether the proliferation of the cells was slow or fast. The law of Bunsen-Rosco, which holds for photochemical reaction, is invalid for the biologic effect of radium rays.

ERNST A. POHLE, M.D., Ph.D.

Epithelioma of the Penis Treated by Radium. W. Maxwell and H. M. Moran. *Med. Jour. Australia*, April 4, 1931, I, 409.

Only a single case is described in which a mild chronic balanitis, with tight redundant prepuce, developed into a granulomatous thickening of the prepuce and an indurated cauliflower tumor about 1 cm. in diameter. The diagnosis of squamous-cell carcinoma was confirmed by biopsy. The glands in the groin were palpable but were thought to be normal or mildly inflammatory.

A mould of Colombia paste was made to ensheath the entire length of the penis. Thirty-five milligrams of radium element in seven foci were disposed around the circumference of the mould, with a filtration of 0.5 mm. of platinum. The testes were protected with lead sheeting. The appreciation of the value of the time factor in the treatment of squamous epithelioma renders a minimum exposure time of four days desirable, and in the present case applications were made for ten hours daily over a period of eighteen days. The radium reaction disappeared at the end of six weeks and the epithelioma at the end of three weeks.

The glands of the groin received no treatment, and after fifteen months there is no sign of metastases. The authors recommend, however, that suspicion of glandular masses demand surgical excision, followed by deep X-

radiation or by radium application at a distance.

J. G. STEPHENS, M.D.

The Order of Magnitude of the External Photo-electric Effect of the Human Body and its Dependence upon the Spectral Distribution of the Radium. W. A. Kartschagin and G. S. Warschawer. *Strahlentherapie*, 1931, XL, 174.

The authors worked out a method permitting the measurement of the photo-electric effect of the human body upon being exposed to a quartz mercury vapor lamp. If the emitted radiation was filtered through ordinary glass, no photo-electric effect could be recorded. A very slight effect was noticeable if the radiation was filtered through blue uviol glass. If the entire emission of the quartz mercury vapor lamp was used, the photo-electric effect of the skin amounted to about 0.65 of the photo-electric effect of iron exposed under the same conditions. The same experiment carried out with radiation filtered through blue uviol glass changes this factor to 0.51. The photo-electric effect of iron following exposure to radiation filtered through uviol glass is only 0.017 of the effect obtained with unfiltered radiation from the quartz mercury vapor lamp. Figures are also given for a comparison of the photo-electric effects measured under varied experimental conditions.

ERNST A. POHLE, M.D., Ph.D.

Radium Therapy. J. H. Montgomery. *China Med. Jour.*, February, 1931, XLV, 101.

The author's interest in radium began with his dissatisfaction with the results of surgery in the treatment of cancer among the Chinese (Matilda Hospital, Hongkong). He tried lead first but never saw much benefit to the disease locally, although there was subjective improvement, and soon gave up the method because of production of anemia and kidney lesions. He began to use radium and became optimistic as to its possibilities, and obtained permission to study its use in Japan, America, England, Scotland, Ireland, and Germany.

The American school, as a whole, is more

inclined to give larger doses over a shorter period than the British and Continental schools, which give smaller doses over longer periods; at the Mayo Clinic, however, they believe the latter more effective and less dangerous than the former—which the author thinks is becoming an almost universally accepted view. He mentions that Kelly is said to possess more radium than anyone else, and extols his work. He saw case after case apparently cured by Kelly's method, with no mutilation and very little scarring, and is convinced that radium, combined with deep X-ray, gives results that surpass the best surgery.

In England, the Radium Institute in London now has a standard course in radium therapy, the clinical and practical work being done at Mount Vernon Hospital, a very large institution devoted entirely to cancer. Marie Curie Hospital, London, is unique, conducted entirely by women doctors; it treats only cases of uterine cancer. The author found the work there "nothing short of miraculous": large carcinomas of the cervix sometimes cleared up in from 2 to 3 weeks, while early cases seemed to disappear almost with one treatment. They use for cancer of the body, 75 mg.-mins. radium element enclosed in 0.50 mm. platinum needle, again enclosed in a small pure vegetable rubber catheter end. At the same time they use a small bomb-like applicator for the vagina with 50 mg.-mins. radium screened with 0.50 mm. platinum, 1 mm. lead, and 1 cm. rubber. These are generally left in position for 22 hours; three treatments are given at intervals of one week. If the cervix is the site of the disease, they reverse the amount of radium, putting 50 mg.-mins. into the uterus and 75 mg.-mins. into the vagina. Since the adoption of this method, they have had no cases of vesicovaginal or rectovaginal fistula. Their full statistics will be published soon. Montgomery's impression is that they are better than Schmitz'. Birkett's work (Manchester) on cancer of the tongue is as good, if not better, than work done elsewhere. He also has excellent results with rodent ulcers, and although the X-ray, as a rule, can cure these cases, with radium there is less danger of a scar—he uses platinum screening chiefly, as it is safest and best.

A new rule in Paris made it impossible for the author to see the work done there, as one must attend a six-months course or remain only 24 hours, during which time one sees only the preparation of radon seeds, radium tubes, and needles, but no clinical work. In Berlin, they too combine the X-ray and radium, but are somewhat limited in research and clinical work by insufficient amounts of radium.

In breast cancer, the general impression gathered is that operation is better in early cases, to be followed by needling or irradiation from Colombia paste mold. Advanced inoperable cases are often made operable by irradiation, recurrences being best treated with radium only. In cancer of the stomach, intestines, kidney, pancreas, and spleen, surgery still holds the field, but the author is hopeful of the devising of new radium methods to deal with these localizations—perhaps through the radium bomb. For cancer of the face, tonsil, tongue, soft palate, and larynx, radium gives far better results than surgery. "By no means is radium a cure for all cases, yet fatalities and recurrences are not the fault of the radium, but occur because of the difficulty of giving a lethal dose to the cancer cells without destroying the healthy tissues."

ROENTGENOTHERAPY

Roentgen Therapy of Spondyloarthritis Deformans. Sepp Grauer. *Schweiz. med. Wchnschr.*, Feb. 14, 1931, LXI, 151-154.

Spondyloarthritis is found in 3.5 per cent of all roentgen examinations of the spine, according to Pokrovskyi. The author feels that this percentage is not excessive. Of 170 cases, 71 per cent were males and 29 per cent females. Most of the male patients performed severe manual labor. The age distribution was from 35 to 70 years. The changes are most marked at the junction of a relatively stable portion of the spine with a sector which is exposed to free motion, i.e., the dorso-lumbar or lumbo-sacral junction.

A description of the typical roentgenologic picture is given, as well as a discussion of the clinical picture. The factors of irradiation

are: Focal skin distance, 30 cm.; filtration, 0.3 mm. zinc and 2 mm. aluminum; fundamental wave length 0.1 Ångström. A dosage of 6 H is given, using an anterior port from 4 to 6 cm. wide, covering the involved area. This is repeated three times, at intervals of seven days. The patients may be divided into two classes: Those who note an immediate response, and those who are improved only after an interval of several weeks. The improvement consists of relief of pain and increased mobility.

H. C. OCHSNER, M.D.

The Prevention of Keloids by Prophylactic Roentgen Treatment Immediately after Operation. Martin Bab. *Deutsche med. Wchnschr.*, Feb. 20, 1931, LVII, 319.

In order to prevent keloid formation after cosmetic operations, the author irradiated the wounds 12 hours post-operatively. One-third E.D. (quality not given) was applied, and the same dose was repeated three days later. The histories of two patients are briefly related, both of whom developed keloids following former operations. No keloids developed after the use of prophylactic roentgen treatment following re-operation.

ERNST A. POHLE, M.D., Ph.D.

Therapy in Sleeplessness. Heinrich Uiberall. *Med. Klinik*, March 27, 1931, XXVII, 465.

The results of trying to influence certain types of sleeplessness (agrypnias) by roentgenotherapy are reported. One must differentiate between two types: (1) The primary agrypnia, which is probably caused by disturbances in the regulatory center, situated in the basal portion of the brain, and (2) secondary agrypnia. It is known that, for instance, an encephalitis lethargica may bring about pathologic changes in this "sleep center." These cases of primary agrypnia are encountered fairly often, as the results of the treatments may indicate. Thirty cases of sleeplessness were treated in the Neurologic Department of "Spitales der Israelitischen Kultusgemeinde," in Vienna. Nine of these

belonged to the secondary type and showed no change, and 21 were of the primary agrypnia. In 10 of these latter, a full success could be achieved, 4 cases showed improvement, 3 questionable improvement, and 4 showed no result. Some of these cases were observed for 2½ years.

The technic used was as follows: Single doses of about ⅓ skin erythema dose, with a filter of 0.5 mm. Zn, 170 K.V., 30 cm. focal skin distance through three fields (6 × 6 cm.); two of them through the temples and one through the middle of the forehead. The interval was from 2 to 4 days, and the whole series was repeated after 3 or 4 weeks. The rays were directed toward the hypophysis. The results of this treatment in cases of primary agrypnia seem to promise well enough to justify the treatment in selected cases.

H. W. HEFKE, M.D.

The Influence on Medical Thought and Practice of the Progress Made in Modern Roentgenotherapy. Hans Holfelder. *Deutsche med. Wchnschr.*, Jan. 9, 1931, LVII, 47.

The author analyzes the present situation in Germany concerning the training of roentgenologists, and emphasizes the importance of the creation of chairs of clinical roentgenology in all universities. He feels that this would help materially in changing the skeptical attitude of the medical profession toward radiation therapy.

ERNST A. POHLE, M.D., Ph.D.

Pigmentary Reaction in *Rana Clamitans* Larvæ Following Treatments with X-rays. William T. Levine. *Proc. Soc. Exper. Biol. and Med.*, March, 1931, XXVIII, 594.

The author described two stages of the pigmentary reaction in tadpoles following X-ray treatment. Ten tadpoles were given eight treatments of 92 K.V., 5 ma., at a distance of 10 inches from the cathode, for 10 minutes, every other day. Six days after the last treatment the animals were killed and sections made. Near the end of the treatment it was noted macroscopically that the previously

round pigment dots became streaky or comma-shaped, and converged towards one or several centers, located usually in the scapula and the pelvic regions. A hyperplastic rise of the epidermis was observed in these regions. This was followed by a perforation in the center, plugged with a blood clot. Sections and whole mounts revealed that the formerly irregularly placed epidermal melanophores had arranged themselves in one direction, apparently making use of ameboid movement to approach the region of injury. In this area, however, they were found contracted and broken up into many black droplets.

Another group of ten tadpoles was exposed on two consecutive days for 45 minutes to 125 K.V., and 5 ma., at a distance of 10 inches. After the second day the epidermis began sloughing off and the stratum corium was exposed.

J. N. ANÉ, M.D.

What is the Value of Roentgenotherapy in the Sterilization of Diphtheria Bacillus Carriers? Rudolf Wahl. *Deutsche med. Wchnschr.*, Feb. 13, 1931, LVII, 276.

One hundred and thirty-six bacillus carriers (133 diphtheria, 1 streptococcus, and 2 meningococcus) were treated by roentgen rays. The first dose amounted to a 30 per cent E.D., and the second or third to a 10 per cent E.D. Babies received only half of this amount. One hundred and five cases were free after one exposure, 28 after two exposures, and 2 after three exposures. One remained positive even after the third exposure. Later examinations were returned, however, as negative. In view of these excellent results, roentgenotherapy is recommended in the treatment of bacillus carriers.

ERNST A. POHLE, M.D., Ph.D.

Roentgen Therapy of Psoriasis: A Source of Danger for Physicians and Patients. Karl Hoede. *Deutsche med. Wchnschr.*, April 3, 1931, LVII, 581.

Psoriasis cannot be cured by roentgen rays, and it is dangerous to continue the treatment over too long a period. High doses do not

give better results than very conservative doses. Other remedies, for instance, ointments and ultra-violet radiation, should first be given a thorough trial before considering roentgenotherapy. It is unwise to exceed doses of from 25 to 100 r in one sitting. They may be repeated two or three times at intervals of four weeks. One should not administer more than one E.D. per year per area. The records of medico-legal cases bear out these statements.

ERNST A. POHLE, M.D., Ph.D.

The Present Status of Treatment of von Recklinghausen's Disease (*Osteodystrophia Fibrosa*). F. Mandl. *Wien. klin. Wchnschr.*, March 13, 1931, XLIV, 360.

The following course of treatment seems to be indicated in von Recklinghausen's disease (localized form): If the disease is limited to a rather small area and is benign, from the roentgenologic standpoint—incision and curettage; if larger areas are attacked and a sarcoma cannot be excluded—resection of a portion of the bone, with a bone graft; post-operative—roentgenotherapy. Repeated roentgenologic examinations should be made to exclude malignant degeneration. As to the generalized form, treatment is surgical as related to the parathyroids. If changes in the calcium metabolism are present, a tumor of the parathyroids should be searched for, possibly supplemented by surgical removal of the tumor or of one normal parathyroid followed by roentgenotherapy to the diseased portions of the bones.

H. W. HEFKE, M.D.

Experimental Foundations of Roentgen Therapy in Inflammatory Processes. F. Freund. *Strahlentherapie*, 1931, XL, 333.

Based on experimental work concerning the effect of roentgen rays on the healing of wounds, the author relates his conception of the influence of roentgen rays on inflammatory processes. He believes that an increased transparency of the blood vessel walls is an important factor. An erythema dose up to 75 per cent may be given, according to Freund.

in chronic inflammations to bring about complete regression of the "inflammation cells." Highly filtered radiation of short wave length is most effective. Even after healing has apparently occurred, additional treatment, with from 40 to 50 per cent E.D. one month later, seems advisable to assure permanent cure.

ERNST A. POHLE, M.D., Ph.D.

Changes of the Biologic Properties of Membranes under the Influence of X-rays. Erwin Saxe. *Strahlentherapie*, 1931, XL, 125.

The author studied the influence of roentgen rays on membranes. Following exposure to 3,000 r, the diffusion velocity was definitely reduced, as compared with an unexposed control. For a lower dose (2,000 r), the effect was still present, but to a lesser degree. These observations open very interesting possibilities for experiments on biologic objects.

ERNST A. POHLE, M.D., Ph.D.

Our Experience with Roentgenotherapy in Hypertrophy of the Prostate. H. Boit. *Deutsche med. Wchnschr.*, Feb. 27, 1931, LVII, 351.

In this article, the author analyzes 114 cases of adenoma of the prostate which have undergone roentgenotherapy. They were not selected: 8 belonged to the first stage, 22 to the second stage, 6 had acute retention, and 78 belonged to the third stage. On three successive days, three fields of 6 X 8 cm. were given over the anterior and posterior pelvis and over the perineum (185 K.V., 4 ma., 0.5 Zn + 1.0 Al). The dose per area amounted to 80 per cent E.D., which led to a dose of about 94 per cent effective in the prostate. The testicles were protected. Shortly before each treatment, the bladder was emptied, washed with boric acid solution, an enema was given, and 10 c.c. of a 50 per cent glucose solution was injected intravenously. If necessary, the treatment was repeated at intervals of four weeks.

Of the 114 patients, 10 died during the treatment from other diseases, 91 became free of symptoms and had no retention. Among these were all of the 8 patients belonging to the first

stage and all of the 6 having acute retention. Six cases were improved, having a retention of from 10 to 200 cubic centimeters. There were 7 which did not improve. Among the improved patients, there were 2 and among the unimproved, 3 who returned for further treatment. Several of the unimproved cases had, in all probability, a carcinoma; this was proved in one case on which an autopsy was performed later. Fifty-one cases could be followed up by letter, and 35 were examined one to five years after the treatment. This leaves a total of 86 patients for an evaluation of the results. Twenty-eight of the 51 traced patients had died, and 23 were alive at the time of the inquiry. Eleven patients had died from other diseases, 12 from complications of the prostatic disease, and 5 from unknown causes. Of the 23 living cases, the bladder function was good in 15, satisfactory in 5, and poor in 3. Of the 35 examined patients, 19 had no retention, 16 showed a retention of from 10 to 95 c.c., but were, however, satisfied. Expressed in percentages, this would mean that in more than 50 per cent of all cases the result was good one to five years after the treatment. About 25 per cent were in satisfactory condition, and in the remaining 25 per cent the result was poor. In 30 per cent of the patients, a recurrence took place; about one-third of these responded, however, to additional treatment.

Too many repetitions of the treatment must, however, be avoided, since this may lead to a fibrosis of the pars prostatica, causing the same symptoms as a stricture. Of all patients discharged without symptoms and without retention, 32 remained well longer than one year; of these, 13 were well for 1 or 2 years, 9 for 2 or 3 years, 8 for 3 or 4 years, and 2 for 4 or 5 years. The therapeutic effect of the treatment on the amount of retention does not manifest itself before from 10 to 14 days after the exposure.

The author concludes that roentgenotherapy, with relatively high doses, is the method of choice in inoperable cases of adenoma of the prostate. In the operable cases of the second and third stages, prostatectomy is preferable. If operation is refused, radiation ther-

apy usually offers good results. This may be improved by further development of the treatment technic. Not more than four or five series should be given, because of the danger of fibrosis in the pars prostatica.

ERNST A. POHLE, M.D., Ph.D.

SINUSES (DIAGNOSIS)

Chronic Infections of the Maxillary Antra in Systemic Disease: A Radiological Study. G. E. Richards. *British Jour. Radiol.*, March, 1931, IV, 120.

For the detection of the less marked pathologic changes in the muco-periosteum of the maxillary sinuses, the technical quality of the films must be of the highest, and even then "plain" films may not clearly show the changes. Quantities of viscid material, certain small cysts, and slight degrees of inflammatory thickening may be present and be productive of symptoms, yet defy detection by any ordinary examination, either clinical or roentgenologic, except by radiographic study after the injection of the sinus with some contrast medium, such as lipiodol, diluted to one part in four of olive oil. For proper filling and the avoidance of pseudo-filling defects, it is necessary to anesthetize the nose and puncture the antrum with a small trochar, through which sufficient oil is injected completely to fill and overflow the sinus. Ordinarily, the two antra are injected and studied simultaneously.

In the normal antrum the filling is, as a rule, quite smooth, although, occasionally, anatomical irregularities or bony septa are found. A number of patients with either localized or more generalized tissue hyperplasia within the antrum have shown prompt relief from asthmatic attacks, recurrent colds, bronchitis, and low-grade pyrexia upon radical removal of the chronically infected tissue in the walls of the diseased sinus. The author feels justified, on this basis, in advocating the contrast-film examination, even in the presence of a "dry tap" by the rhinologist and essentially negative sinus films by the plain film method.

J. E. HABBE, M.D.

Roentgenologic Diagnosis in the Field of Oto-rhino-laryngology. E. Wirth. *Röntgenpraxis*, March 15, 1931, III, 241.

The roentgenologic examination has developed into a valuable and sometimes necessary diagnostic means for otology and rhinology, but not so much for laryngology. From the roentgenologic examination alone, however, a correct diagnosis can be made in only very few cases, and should be considered only a valuable aid to the other clinical methods of examination. One thousand five hundred forty roentgenologic examinations of sinuses and 660 examinations of the mastoids were made in one year, about every fourth patient being subjected to the X-ray examination in the clinic. This number shows that the roentgenologic examination is of definite value in this specialty. The technic and the reading of the films are difficult, especially of the mastoids. An extensive experience is necessary to evaluate slight changes from the normal in mastoid and sinus films. Really, the clinician can acquire the experience only when he does the technical work and the interpretation himself. He alone can follow up the cases and compare the roentgenologic findings with the clinical picture and the operative findings. Interpretation of complicated films of mastoids and sinuses would be very difficult for a roentgenologist who has had no special experience in otology and rhinology. In this field, close co-operation between the roentgenologist and the clinician is absolutely necessary.

H. W. HEFKE, M.D.

SKIN (THERAPY)

The Radiotherapeutic Treatment of Cutaneous Epitheliomas. J. Laborderic. *Arch. d'Électricité Méd.*, March-April, 1930, XXXVIII, 145.

It is believed that radiotherapy is preferable to surgery in the treatment of cutaneous epitheliomas, because of the necessity of radical operation and subsequent mutilation and scarring in the latter. In the application of radiotherapy, however, the author believes, as

does Regaud, that a malignant tumor should be completely destroyed by the first application, and if this does not occur it will become more malignant. Broca administered at one application from 20 to 30 H, without filtration, and claimed that this massive dose had never produced a dermatitis, provided care was taken to protect the normal skin. The author believes that the rays of moderate wave length are sufficient to kill all the cancer cells if the dose given is large enough. The more penetrating rays are not only useless but also dangerous because of their effect on the deeper organs.

He reports a series of 40 cases of cutaneous epitheliomas treated by the X-ray, in which all but 2 patients were cured by a single application. His technic consisted of a single application of 110 K.V. (maximum), at 3 ma., without filtration. It was determined by the ionometer that a dose sufficient to kill cancer cells was obtained in about 25 minutes, with the above technic. Using a pastille of the chromoradiometer of Bordier, near the lesion, tint IV resulted in about 25 minutes.

In from 8 to 13 days the patient experienced more or less itching, and a serous exudation occurred, which formed a crust. Later, the odor and exudation disappeared, and after a time a white smooth scar replaced the ulcerated area. Antiseptic precautions should be used during this interval. Magnesium chloride was found helpful to facilitate the elimination of the slough, which should not be removed by traction.

J. N. ANÉ, M.D.

Late Injuries Following Roentgen Treatment of Skin Diseases and Conclusions Concerning the Technic. H. Fuhs and J. Konrad. *Strahlentherapie*, 1931, XL, 254.

In 9,293 cases treated by roentgen rays for some skin disease, a total of thirty-three late reactions were observed. They are distributed, according to disease, as follows: Acne vulgaris (2), condyloma acuminatum (1), eczema chronicum (3), eczema seborrhoicum capitis (1), epilation (microsporon, trichophyton, favus) (8), erythema induratum

exulceratum (1), hypertrichosis (2), keratosen (arsen) (1), lupus vulgaris (3), morbus Bowen (1), psoriasis vulgaris (3), skrophuloderm (3), tuberculosis verrucosa cutis (3), verrucae vulgaris (1).

The authors analyzed each case in detail in order to determine the possible cause for the observed injury. Certain precautions are suggested to prevent such undesirable results in the future, even though the percentage of late reactions must be considered very small. In children below 4 years of age, for instance, the authors do not epilate any more. In psoriasis, roentgen rays should be used only when all other means have been exhausted, and then only in doses of from 50 to 100 r, given once or twice. Eczema must also be treated with conservative doses, particularly should the intervals between series be sufficiently long. Caution is also indicated in skin tuberculosis. For warts, doses of from 200 to 300 r (0.5 to 4.0 Al), depending on the type of lesion present, will be sufficient. The treatment should not be repeated before six or eight weeks.

In view of the valuable data presented in this paper it is recommended for study in the original.

ERNST A. POHLE, M.D., Ph.D.

Ten Years' Experience in the Treatment of Psoriasis by Thymus Exposure. C. Speierer. *Strahlentherapie*, 1931, XL, 272.

An analysis of 50 cases of psoriasis, treated by roentgen exposure of the thymus, revealed that in not a single case could a permanent cure be obtained. In a few patients, temporary disappearance of the lesions was seen. Recurrence took place, however, within a year. It was striking that mostly young patients responded to the thymus treatment; there existed apparently no difference between the two sexes. A change in the technic did not alter the results. Therefore, Brock's original procedure was adopted (50 per cent E.D., 3 mm. Al for adults, and from 25 to 33 per cent E.D. for children; moderate penetration).

As it is known that the thymus decreases promptly in size after the application of even

very small doses of roentgen rays, the author believes that the theory of a stimulation effect on the thymus cannot be upheld. He feels that there may be a connection between psoriasis and tuberculosis. The beneficial results following exposure over the upper mediastinum could be due to an effect upon the glands in that region, since it is well known that tuberculous glands usually respond to roentgen treatment.

ERNST A. POHLE, M.D., Ph.D.

Seventh International Congress of Dermatology and Syphilography, Copenhagen, August 5-9, 1930. G. Solente. *Ann. de derm. et syph.*, Paris, 1931, II, Ser. 7, 1.

The author has made a review of all the papers presented at the last Congress of Dermatology and Syphilography. In studying "Cutaneous Tuberculosis and its Treatment," a number of papers were presented which mentioned the use of various types of light therapy (Finsen, voltaic arc, Kromayer lamp, ultra-violet, radiotherapy, Duflot-Dufestel lamp, etc.), including the following:

Treatment of Tuberculosis of the Skin. Axel Reyn. (Pages 75-79.)

Treatment of Lupus Vulgaris (Traitement du lupus vulgaire). Paul Francois. (Pages 82, 83.)

Cutaneous Tuberculosis. R. Volk. (Pages 84, 85.)

Lupus Vulgaris. Porcelli. (Page 95.)

Local Treatment of Lupus (Traitement locale du lupus). Marceron. (Page 95.)

Treatment of Cutaneous Tuberculous Lupus (Traitement du lupus tuberculeux cutane). Jauson. (Page 102.)

Radiotherapy by Coste's Method (Only One Sitting, Short Wave Length, No Filtration) in the Treatment of Certain Types of Cutaneous Tuberculosis (Radiotherapie selon la methode de Coste—seance unique, courte longueur d'ondes, pas de filtration). Nicolas, Gate, Coste, and Michel. (Page 103.)

Treatment of Lupus by Subcutaneous Radium (Traitement du lupus par le radium souscutane). Th. Behaegel. (Page 103.)

Pigment and Protection against Light (Pig-

ment et protection contre la lumiere). Ph. Keller. (Page 123.)

Rational Cutaneous Therapeutics with Limit Rays (Therapeutique cutanee rationnelle par les rayons limite). G. Bucky. (Pages 123-125.)

Use of Limit Rays in Dermatology (L'emploi des rayons limite dans la dermatologie). A. Kissmeyer. (Page 125.)

Present State of Dosimetry in Dermatology (Situation de la dosimetrie dans la dermatologie. Schreus. (Page 125.)

Irradiation of the Thyroid in Diseases of the Skin (Irradiation de la thyroide dans les maladies de peau). Julius Samek. (Page 125.)

Radiographic Picture of the Posterior Urethra in Gonorrhea (L'image radiographique de l'urethre posterieur dans la gonorrhée). Richard Fruhwald. (Page 126.)

SKULL (DIAGNOSIS)

Schilder's Encephalitis Periaxialis Diffusa: Report of a Case in a Child Aged Sixteen and One-half Months. Myrtelle M. Canavan. *Arch. Neurol. and Psychiat.*, February, 1931, XXV, 299.

The author gives a detailed report of a case affected with this disease. It is characterized pathologically by degeneration of the white matter in the brain, and there may be evidences of scavenger cells and also an increase of glia and edema of the white matter near the cortex. This disease is of interest to the roentgenologist because it may produce evidences of increased intracranial pressure on the roentgenogram.

Incidentally, the disease was first described by Schilder of Vienna, in 1912, and only twenty-eight cases had been reported up to July 1, 1929.

C. G. DYKE, M.D.

The Technic of Encephalography. Carl D. Camp and R. W. Waggoner. *Arch. Neurol. and Psychiat.*, January, 1931, XXV, 128-136.

Encephalography as a diagnostic procedure is well recognized. It has also been suggested

and frequently used as a therapeutic measure. The two objections to such use are: (1) The severe reaction which the patient experiences during and after the injection of air, and (2) its danger to patients who show much increase in intracranial pressure, especially in the presence of choked discs, tumors of the brain, and particularly lesions of the posterior fossa.

Since, to some extent, the distress of the patient is in proportion to the amount of movement to which he is subjected, a chair has been constructed in which the patient may be placed before the procedure and in which he may remain until he is returned to his bed. The puncture may be done with the patient in the prone or upright position in the chair. In either case, he is seated for the injection of air.

A second device which has been of great assistance is a special X-ray tube and Bucky diaphragm stand. This stand makes possible a constant X-ray technic which not only facilitates the mechanical part of the procedure, but also standardizes the films by making the relation of the patient's head, the X-ray tube, and the film constant, thus making interpretation much easier.

Roentgen Diagnosis of Disease at the Base of the Skull. R. Pomeranz. *Arch. Otolaryngol.*, January, 1931, XIII, 63.

The roentgen diagnosis of intracranial disease is one of the most difficult chapters in diagnosis. One of the most prominent of the recent workers in this field is E. G. Mayer, assistant to Professor Holzkecht in Vienna. He not only has introduced new positions in the technic, but also has achieved remarkable results in the interpretation. The author considers as ideal the combination of an exceptionally large clinical and roentgenologic knowledge, which, however, is rare. A happy medium for the average physician would be the co-operation of the clinician with the roentgenologist, both before and after the roentgenologic examination.

Our task is to further the diagnosis of intracranial basal or near-basal tumors by visualization and proper interpretation of the bony changes of the skull, particularly of the base of

the skull and of the sinuses. For a good general survey of the main structures at the base of the skull, two views are necessary, namely, frontal and sagittal. Of the numerous special views cited, three are particularly important: (1) Axial view of the middle fossa (Schüller) taken in the submentobregmatic direction, if possible; (2) the Stenvers view of the pyramis; (3) oblique view of the orbit by Rhese as modified by Goalwin, visualizing the optic canal, which is of diagnostic value only in selected cases. The author does not believe it advisable, for several reasons, to use the Bucky diaphragm in the diagnosis of diseases of the skull; it is also not advisable to use large distances and large cones in this work.

He then discusses the roentgenologic differentiation of various pathologic changes at the base of the skull: increased endocranial pressure; sellar erosions; changes in the body and wings of the sphenoidal bone; pathologic changes in the pyramids—mastoid portion and rest of the pyramids; inflammatory changes of the mastoid; cholesteatomas; tumors of pyramidal eminence; sinus involvements from various causes, and basal injuries (fissure fractures).

SKULL (THERAPY)

Modern Treatment of Increased Intracranial Pressure. Foster Kennedy and S. Bernard Wortis. *Jour. Am. Med. Assn.*, April 18, 1931, XCVI, 1284-1286.

A clearly formulated plan of treatment could be solved only by the proper application of exact physiologic knowledge regarding intracranial pressure changes brought about by protean factors, such as sleep-waking, changes in posture, respiratory variations, and the exact effects of many different drugs.

Extensive experiments were carried out on patients having bone defects in the skull, beneath which defects the dura had been cut and left unsutured. Pressure conditions inside the skull were transmitted by tambour to a pointer recording on a revolving drum. The results germane to this discussion were as follows:

Sleep is accompanied by an increase of intracranial pressure: the act of wakening is coincident with a decrease of this pressure; morphine, glyceryl trinitrate, hypotonic solutions, and the assumption of the horizontal position all cause heightened pressure within the skull. This was true also as regards coughing, stool straining, struggling, and ether anesthesia. On the other hand, intracranial pressure was invariably reduced by raising the head above the level of the heart. Caffeine sodio-benzoate given below the skin or into a vein reduced intracranial pressure promptly. The same was true of hypertonic solutions, periodically sustained deep breathing, and the removal of cerebrospinal fluid by the lumbar route.

The causes of increased intracranial pressure in the order of their frequency are: (1) Skull fracture; (2) brain tumor; (3) meningitis; (4) cerebral hemorrhage and thrombosis; (5) subarachnoid hemorrhage; (6) hydrocephalus due to inflammation around ventricular foramina; (7) hypertension associated with headache, and (8) acute cerebral edema.

The major operations should not be resorted to until all the other procedures have proved futile and incapable of arresting steadily increasing pressure within the skull.

CHARLES G. SUTHERLAND, M.D.

Management of Head Injuries. L. D. McGuire. *Nebraska St. Med. Jour.*, November, 1930, XV, 427.

The only cases of acute head injuries which should be taken immediately to the operating room are those with severe scalp lacerations and open vessels, or those with markedly depressed skull fracture. Most of the head injuries should be rushed to bed and not to the operating room. Cases of concussion should have three weeks in bed as a minimum, for concussion means an actual head injury. Only rarely is a skull fracture of serious moment, and the essential treatment is that of the profound shock; the determination of the presence or absence of skull fracture is of secondary importance. After the patient has re-

covered from shock, he may have X-ray examination for possible fractures of the skull.

W. W. WATKINS, M.D.

SPINE (DIAGNOSIS)

A Peculiar Type of Vertebral Synostosis in a Kyphosis of Adolescent Age. Kurt Lindemann. *Röntgenpraxis*, March 15, 1931, III, 267.

In a fifteen-year-old girl, a fixed dorsal kyphosis developed gradually from a static kyphosis of the adolescent type. Roentgenologic examinations were made during the progress of the disease, which showed narrowing of the intervertebral discs, irregularities in the structure of the enchondral growth zones of the vertebræ, and increased density in the anterior parts of the discs. This chronic and symptomless process led finally to a partial synostosis of some of the vertebræ. The differential diagnosis is given in detail, and a congenital etiology is denied by the author. One deals either with changes caused by the adolescent type of a kyphosis or with an infectious metastatic process.

H. W. HEFKE, M.D.

Spondylitis Deformans. Samuel Kleinberg. *Arch. Surg.*, March, 1931, XXII, 485.

Spondylitis deformans is a progressive disease of the spine characterized by gradually increasing flexion of the trunk and ankylosis of the vertebræ. The disease usually comes on insidiously but may begin with an attack similar to lumbago. If the patient is seen during the early course of the disease, it will be found that he stands and walks with his head bent forward. The spine is symmetrical but flat. There is definite limitation of motion. If the patient attempts to straighten up, it can be seen that there is very slight motion in the spine itself, but the trunk is hyperextended on the hips.

At first, the X-ray examination of the spine may be entirely negative, or may show marginal lipping or osteophytes. As time goes on, however, there is an increasing ankylosis of the spine until finally the vertebræ all become fused into one mass. The ribs may also be-

come fixed through ankylosis of the costovertebral joints. Breathing is entirely abdominal.

The disease occurs more frequently in males than in females, and usually between the ages of twenty and forty. The author states that the removal of infectious foci, such as diseased tonsils or teeth, does not usually have a beneficial effect on the vertebral lesion.

The local treatment of this condition is concerned first with the correction of the deformity; secondly, with the mobilization of the spine whenever possible, and thirdly, the relief of backache. When the condition of the patient has progressed to the stage of bony ankylosis of the vertebræ, the deformity and disability are permanent and irremediable. In the earlier stages, however, before there is ankylosis, the deformity can often be corrected slowly by treating the patient on a convex frame. Later a brace is applied to maintain the position. Baking and massage are administered during the course of the active treatment on the frame.

HOWARD P. DOUB, M.D.

The Intervertebral Disk. Emil S. Geist. *Jour. Am. Med. Assn.*, May 16, 1931, **XCVI**, 1676-1679.

Due to Professor Schmorl, of the Dresden Pathologic Institute, an increase in knowledge of pathologic changes in the spine has been acquired in the past five years. He has indicated the anatomy, physiology, and pathologic anatomy of the intervertebral disk. There is not possible a single motion of the spine without the aid of the intervertebral disks.

The disks are intimately attached to the compact bony rim of the vertebral body and loosely to its sieve-like surface. They contain in the adult neither blood vessels nor nerves. A disk is composed of three distinct parts: (1) The nucleus pulposus; (2) the annulus fibrosus, and (3) the cartilage plate ("knorpelplatte," Schmorl).

The microscopic anatomy shows an intricately planned mass of fibrocartilage surrounding the nucleus pulposus with few, if any, elastic fibers. The nucleus pulposus is normally situated slightly behind the median line. It

is composed chiefly of the remains of the notochord, a semi-fluid ground substance, debris, and cartilage cells. It is comparatively large in children and recedes in size as age advances. Normally it never disappears.

The annulus fibrosus forms the major portion of the intervertebral disk. It is composed of fibrocartilage and is firmly attached to the cancellous rim of the vertebral body. The cartilage plate is in contact with the surface of the vertebral body, rather loosely attached to the underlying sieve-like surface of the vertebral body, and can be readily detached. Roentgenograms showing notchings in the anterior and posterior surfaces and upper and lower anterior rims are given anatomic explanation.

The function of the disk is discussed in detail. Pathologic conditions of the disk, congenital anomaly, and calcification are rare. Prolapse of the disk was present in 38 per cent of 3,000 autopsies. Where prolapse has existed for some time, new bone may be laid down and is often seen roentgenologically. Chronic spondylitis should be used only to describe an inflammatory process of the body and disk. Arthritis should be reserved to diseases of the posterior intervertebral joints, which are true joints. Conditions in which pathologic conditions of the disk are of a secondary nature, are discussed.

CHARLES G. SUTHERLAND, M.D.

THROAT (DIAGNOSIS)

The Diagnosis of Laryngeal Disease: Laryngoscopic Appearances Correlated with Roentgenologic Observations. Chevalier L. Jackson. *Jour. Am. Med. Assn.*, Nov. 1, 1930, **XCV**, 1322.

In this essay the laryngoscopic appearances are correlated with the roentgenologic observations. Patients with early and easily operable cancer or incipient tuberculosis may be allowed to go for months without an accurate diagnosis and appropriate treatment through failure to make a careful diagnostic study. A diagnostic study entails (1) a complete history; (2) mirror laryngoscopy; (3) roentgenographic study of the neck and chest

and, in most cases, of the sinuses; (4) complete general physical examination, with particular attention to the chest; (5) blood Wassermann test; (6) sputum analysis; (7) direct laryngoscopy (if indicated), and (8) biopsy (if indicated). A series of case reports stress the characteristics of various types of disease.

The recent work of Pancoast and Pendergrass has developed the roentgenology of the neck to such a degree that the fluoroscopic and roentgenographic study of the larynx itself is of the greatest importance in diagnosis. The author acknowledges the value of fluoroscopic and roentgenographic study of the neck, and states that the roentgenologist can now detect inflammatory and neoplastic processes in their incipience, when they are causing only the mildest symptoms.

C. G. SUTHERLAND, M.D.

THYROID (DIAGNOSIS)

Intrathoracic Goiter. George M. Curtis. Jour. Am. Med. Assn., March 7, 1931, XCVI, 737.

Still too frequently patients are seen with intrathoracic goiter that has escaped recognition even in competent hands. This is due to the fact that a meager symptomatology has not seemed to warrant taking a roentgenogram of the trachea. Since the treatment is essentially surgical, it is of advantage to practice this early before the goiter has become too large, adherent, or even malignant.

Wuhrmann's monograph is still a mine of information for students of this disease. The total or complete intrathoracic forms may occur with or without a cervical goiter. The partial forms seem to be the most confusing since they are intermediate between the deep and the total intrathoracic goiter. They are always accompanied by a cervical goiter, a greater part of which extends into the thoracic cavity and remains there even on swallowing or straining. Those that grow toward the median line and anteriorly are commonly called retrosternal, substernal, median, or mediastinal. Those more lateral in position

are designated as lateral, suprapleural, and retroclavicular or, more frequently, subclavicular. The diagnosis of intrathoracic goiter is readily made by the X-ray. Fluoroscopy is of great aid in the differential diagnosis of the intrathoracic tumor. It is generally stated that intrathoracic goiters move on swallowing. Carcinoma with surrounding infiltration, a narrow connecting stalk between the thoracic and cervical goiter and fixation at the inlet, all tend to immobilize the intrathoracic shadow under the fluoroscope. The treatment is essentially surgical.

CHARLES G. SUTHERLAND, M.D.

Hyperthyroidism and Associated Pathology. William Lewis. Am. Jour. Med. Sci., January, 1931, CLXXXI, 65.

This article comprises a study of 12 necropsies on patients who suffered from hyperthyroidism, with all the clinical findings. The author believes that the anatomic changes in the heart and blood vessels are mainly due to coronary sclerosis, arteriosclerosis, or old rheumatic fever. These pathologic changes, when present, are compatible with the age and with each other.

Certain deaths clinically resembling crises or post-operative storms can be ascribed; on pathologic examination, partly or largely to such causes as coronary sclerosis, myocardial failure, or early bronchopneumonia.

No significant anatomic changes were found in the spleen, liver, kidneys, pancreas, adrenals, or ovaries. There was no evidence that hyperthyroidism *per se* has any toxic influence or direct pathologic action on the heart, but, indirectly, it accelerates the development and progress of pathologic lesions from other sources by causing increased work for the heart.

ROE J. MAIER, M.D.

TUBERCULOSIS (DIAGNOSIS)

The Differential Diagnosis between Pulmonary Tuberculosis and Pulmonary or Bronchial Malignant Neoplasms. Channing

Frothingham. *Am. Rev. Tuberc.*, February, 1931, XXIII, 107.

The writer stresses the importance of the differential diagnosis, as in one instance so much can be done, while in the other, little is to be expected from any treatment. Malignant neoplasms of the lung, as found in the Peter Bent Brigham Hospital, show a marked increase. In ten years, from 1913 to 1922, 7 cases were diagnosed; in five years, from 1923 to 1927, 16 cases were diagnosed; in two years, 1928 and 1929, 16 cases were diagnosed.

Examination of clinical histories and laboratory examinations are so varied that the writer frankly states they are of little value other than to suggest "Something unusual is going on." The X-ray examination of the chest is stressed as of tremendous importance, especially serial examinations and re-examination at intervals after X-ray therapy.

Next in importance is the bronchoscopic study, which he finds to be of greatest importance in intrabronchial growths. In metastatic malignant tumors of the lungs, the symptomatology is so varied there is usually nothing that points definitely to the nature of the disease. A series of films showing primary malignancy and metastatic tumors is presented, with a thorough description of the cardinal points in each.

The author arrives at the following conclusions: (1) The physical examination did not show any characteristic signs which were peculiar to malignancy; (2) the clinical pathology was not helpful in making a diagnosis—the blood, sputum, urine, and temperature curves were of no definite value; (3) the diagnosis depends principally on the X-ray findings, although the interpretation at times is difficult; (4) bronchoscopic study of the intrabronchial types at times is positive.

S. C. BARROW, M.D.

The Clinical Classification of Pulmonary Tuberculosis. Sidney J. Shipman. *California and Western Med.*, March, 1931, XXXIV, 172.

The author classifies pulmonary tuberculosis into two groups, namely, proliferative and

exudative, but does not make a differentiation which appears to be helpful to the X-ray interpretation.

F. B. SHELDON, M.D.

Tuberculosis of the Stomach: An Analysis of Cases Recently Reviewed. Ralph W. Good. *Arch. Surg.*, March, 1931, XXII, 415.

Tuberculosis of the stomach is a rare disease of adults. The average incidence, as derived from the total number of necropsies, was 0.34 per cent. The symptoms associated with this disease are pain after meals, loss of weight and strength, and vomiting. In half of the cases, tuberculosis is found elsewhere in the body. The disease is often mistaken for gastric ulcer or carcinoma.

The pyloric end of the stomach is the site of predilection. In most instances, the gross appearance of the lesion is not characteristic unless visible tubercles are present. The real diagnosis is revealed only by microscopic examination.

The presence of an organic gastric lesion can be established with relative ease. The treatment is surgical and, by choice, consists of radical resection of the lesion-bearing portion of the stomach. The roentgen findings are usually those of an organic lesion in the antrum of the stomach.

HOWARD P. DOUB, M.D.

TUBERCULOSIS (THERAPY)

Radiation Therapy in the Treatment of Tuberculous Infections. Marcel Ory. *Strahlentherapie*, 1931, XXXIX, 780.

Tuberculosis is a systemic disease manifesting itself in most cases in local foci. The indications for light therapy vary with the stage of the disease. In the first stage, ultra-violet rays have apparently no effect, since they do not increase the bactericidal qualities of the organism. In the second stage—the congestive period—ultra-violet radiation in erythema doses helps the organism in fighting toxins. During the third stage, or period of sclerosis, the ultra-violet rays have their optimal effect.

It is necessary to continue the treatments for a long time. Although there are no absolute contra-indications, it is necessary to control the temperature of the patient. Those with a tendency to hemorrhage in lung, kidney, or gastro-intestinal tract should not be treated. Tuberculous adenitis and peritonitis, pleuritis, tuberculosis of the small bones, lupus, and tuberculous epididymitis respond best.

ERNST A. POHLE, M.D., Ph.D.

Healing of Tuberculous Cavities. Louis H. Fales and E. A. Beaudet. *United States Vet. Bureau Med. Bull.*, March, 1931, VII, 197.

Contrary to the opinion expressed by others that the presence of cavities in pulmonary tuberculosis gives to the case a rather hopeless outlook, the authors, having studied 147 cavities, are inclined to more optimism. They conclude, however, that the healing depends upon the size of the cavity and the amount of pulmonary involvement.

Their studies are based almost entirely on stereoroentgenograms taken at intervals of three months. The reliability of the X-ray findings has been proven by comparisons of roentgenograms made before and after death, with the postmortem findings. Very rarely, because the cavity wall has not formed or because of absorption and resolution of a thin-walled cavity, a lack of visibility on the roentgenogram has resulted. In this survey, following the work of Bruns, Burnham, and Brown, all annular shadows were considered cavities, unless proven otherwise. While a positive sputum may be present in cavitation, this usually disappears with healing. The physical examination was considered of no value because only 20 per cent of all cavities show the recognized physical signs. With the healing of the cavities, however, there was noted evidence of clinical improvement.

In the healing of cavities, it was noted on the roentgenogram that the annular shadows gradually became smaller and the wall more indistinct. When complete healing occurred, there remained only an area of fibrosis with radiating lines.

that all traces of the cavity may disappear entirely.

Cavities were classified into small (less than 2.5 cm. in diameter), large (2.5 cm. or over), and multiple. In this series of 147 cavities, 56 were small, 44 large, and 47 multiple. Of this total, 62, or 42 per cent, healed. Of the cavities of all classes which healed or became smaller, 69 per cent were in the right and 83 per cent in the left lung. In bilateral cavitation, healing occurred in both lungs in only 9 per cent of these cases.

In their management it was believed that rest treatment was of greater value than pneumothorax, thoracoplasty, or other surgical procedures. Rest should be prolonged for at least from 12 to 18 months. Then, if the cavities show no evidence of healing, resort may be had to other measures.

J. N. ANÉ, M.D.

The Necessity for Combined Treatment of Glandular Tuberculosis. Kurt Mosdzien. *Strahlentherapie*, 1931, XXXIX, 507.

A number of cases with tuberculous glands treated by the author responded best to a combination of local X-ray therapy and general light exposure. Deep therapy radiation (from 150 to 190 K.V., copper filter), except for very superficial glands, was used. Treatment was given two or three times, from 10 to 25 per cent E.D. per sitting, with a three or four weeks' interval between the doses.

ERNST A. POHLE, M.D., Ph.D.

Roentgen Therapy in Tuberculous Diseases of the Eye. A. Lorey and K. Mylius. *Strahlentherapie*, 1930, XXXVIII, 473.

The authors report their results in the treatment of tuberculous affections of the eye, by roentgen rays. They used two types of radiation: 110 K.V., 3.0 or 5.0 mm. Al; 170 K.V., 0.5 mm. Cu+1.0 mm. Al. The single dose amounted to from 50 to 200 r; from 100 to 125 r are recommended for most cases. The treatment should not be repeated before from one to two months, and more than three or four treatments per year are inadvisable.
radium

therapy gives better results than roentgen therapy. Seven milligrams of radium element, filtered through 0.1 mm. Ag and $3\frac{1}{2}$ mg.-hrs. per square centimeter, are suggested. The combination with the cautery gave encouraging results.

Tuberculosis of the cornea was seen in 12 patients; some had been under observation for several years. They seem to respond best to irradiation. In view of the small doses given, there is no danger of an injury to the lens. Twenty cases of iridocyclitis were also seen, but in only two cases could a complete cure be obtained. A number of case histories illustrate the observations. A few cases of tuberculosis of the retina and sclera were also treated by roentgen rays. This small number of cases does not permit, however, any definite statements.

In conclusion, it is suggested that each patient be given a note indicating the dose and quality of radiation received over the eye, in order to prevent additional and excessive treatment in another hospital.

ERNST A. POHLE, M.D., Ph.D.

The Question of Boeck's Sarcoid: A Special Form of Atypical Tuberculosis. J. Michelsen. *Deutsche med. Wchnschr.*, April 3, 1931, LVII, 574.

A case of sarcoid in a 26-year-old girl, with involvement of the lungs, is described. The skin lesions responded to X-ray therapy (40 and 30 per cent E.D., 3 mm. Al). Deep therapy was applied over the lungs (9 fields, 6×10 per cent E.D.). Although the blood count improved and the weight increased, there were no definite changes in the lung findings.

A roentgenogram of the chest and a photomicrogram of a skin nodule are appended.

ERNST A. POHLE, M.D., Ph.D.

TUMORS (DIAGNOSIS)

A Contribution to the Lymphogranulomatosis of the Lungs. Walter Kuckuck. *Röntgenpraxis*, Jan. 15, 1931, III, 79.

The clinical and roentgenologic findings of an atypical case of Hodgkin's disease are de-

scribed. The roentgenologic examination of the chest showed first a large, round, well circumscribed shadow, with a fluid level in the right lower lobe which impressed one as being metastatic. Later another similar tumor was found in the left upper lobe. An autopsy showed these to be lymphogranulomatous tumors. This type of Hodgkin's disease in the lung is seen very rarely.

H. W. HEFKE, M.D.

On the Essential Principles of Malignancy. A. Dietrich. *Strahlentherapie*, 1931, XL, 1.

This is a theoretical discussion of malignant tumors from the standpoint of the pathologist. The article is not suitable for abstracting and should be looked up in the original.

ERNST A. POHLE, M.D., Ph.D.

A Case of a Primary Sarcoma of the Lung in an Infant Twenty-nine Months of Age. Philip Rosenblum and Benj. Gasul. *Arch. Pediatrics*, January, 1931, XLVIII, 63.

A review of the medical literature reveals only two cases of primary sarcoma of the lung in infants. Roentgenologic and pathologic examinations of one case disclosed a huge tumor of the right lung, which displaced the heart and mediastinum to the left. Histologically, it was sarcoma.

E. C. VOGT, M.D.

Intrathoracic Neurofibromas and Their Differential Diagnosis. Thomas Canigiani. *Röntgenpraxis*, March 1, 1931, III, 214.

The roentgenologic differential diagnosis of intrathoracic neurofibromas is very difficult. Such a case is described in detail. The roentgenologic examination showed an intrathoracic mass which was in contact with the thoracic wall. A diagnosis of an encapsulated empyema was made. Another examination, six months later, showed an increase in size and an erosion of the fourth rib, extending about 7 centimeters. The diagnosis was undecided, it being between an echinococcal cyst and a neurofibroma. Clinical means must be employed to make the diagnosis, that is, the exist-

ence of neurofibromatosis of the skin, the negative thoracocentesis, the negative complement fixation test for echinococcus, the absence of eosinophilia, and the marked localized pains. From a roentgenologic standpoint alone, encapsulated empyemas, interlobar empyemas, and echinococcus must be considered. An operation and histologic examination showed that this tumor was a neurofibroma.

H. W. HEFKE, M.D.

Tumors of the Carotid Body: Report of Twelve Cases, Including One of Bilateral Tumor. Fred W. Rankin and William L. A. Wellbrock. *Ann. Surg.*, April, 1931, XCIII, 801.

Abstracts of 12 cases, including one of bilateral tumor of the carotid body, are reported by the authors. In all, they have found 196 cases, after a rather thorough review of the literature.

Anatomically, the carotid body is ovoid, approximately 5 mm. in length, 3 mm. in width, and 1.5 mm. in thickness, and is located on the median and deep aspects of the upper end of the common carotid artery, at its bifurcation into the internal and external trunks. It is firm, of grayish or brownish color, with a fibrous capsule, and contains a hilum at which its arterial blood supply enters. Its two essential elements are blood vessels and cells.

When tumors affect this body they become lobulated or globular and are always encapsulated. A tumor of the body is often designated as "adenoma," "endothelioma," "perithelioma," "paraganglioma," "neuroblastoma," "sarcoma," or simply "carotid body tumor." The last term seems a sensible one until a better term is agreed upon by pathologists. About 80 per cent of the tumors of these bodies are benign, while 20 per cent are malignant. Metastasis to the liver was found in one case, although, as a rule, such is rare. The general structure consists of epithelial cells packed in an endothelial-lined alveolus.

A symptomless lump in the neck, which pulsates without an expansile quality and is usually movable, is the general clinical picture.

Operative removal is usually attempted and the prognosis varies, depending on whether one, two, or three carotid vessels demand ligation.

The patient with the bilateral tumor had one benign and one malignant mass. In the 12 cases (Mayo Clinic), 6 tumors were malignant and 7 benign. Roentgenotherapy was not reported in this paper.

F. B. MANDEVILLE, M.D.

The Roentgenologic Diagnosis of Intrathoracic Tumors. Viktor Mandler. *Röntgenpraxis*, Feb. 15, 1931, III, 151.

The author reviews and describes the roentgenologic symptoms of intrathoracic growths in this excellent and extensive treatise. A large number of reproductions of films help to demonstrate the pathologic changes. Not only primary tumors of the lungs are included, but also metastatic tumors and mediastinal and pleural growths. The author describes the roentgenologic differential diagnosis in detail. The article deserves study in the original.

H. W. HEFKE, M.D.

The Incidence of Brain Tumors in Epilepsy, as Revealed by Routine Encephalography. Nicholas Gotten. *Jour. Am. Med. Assn.*, April 4, 1931, XCVI, 1118-1121.

The use of lumbar insufflation of air to replace cerebrospinal fluid has made possible roentgenographic studies of the brain that clearly show the gross lesions and deformities otherwise undemonstrable. Reports of various observers indicate the value of this procedure in the accurate diagnosis and localization of obscure cerebral lesions.

The encephalogram has demonstrated its greatest value in determining the origin of the convulsions which occur after the third decade of life. Convulsive disorders are often the initial symptoms of brain tumor and often lead to the erroneous diagnosis of epilepsy when the lesion lies close to the motor areas. The normal pathways and encephalographic pattern are shown.

The interpretations of the obstructions to the cerebrospinal fluid pathways, their charac-

teristic changes, and the resultant brain atrophy are reviewed. Filling defects produced by tumors are in sharp contrast to the shrinkage and brain atrophies noted in the degenerative lesions. Plastic arachnoiditis must be differentiated from cerebral neoplasm, but here in the presence of an invasive or progressive growth the ventricular outlines and displacements are diagnostic.

The ventricles may be encroached on, displaced or depressed by the tumor or invasive lesion, whereas plastic arachnoiditis and cortical scar formation produce a traction and distortion of the roof of the ventricle, drawing it toward the area of the lesion.

Three cases of brain tumor, disclosed in routine encephalographic studies on epileptic patients in whom the only prominent symptoms were convulsions, are reported.

The final diagnosis was made only by the completion of the studies by injection of air. One of these cases showed an erosion of bone in the frontal region. An encephalogram clearly demonstrated the presence of a large cerebral neoplasm. The other two showed deformities of the ventricular outline and the patterns of the fluid pathways, which indicated a filling defect and invasive lesion. The size and location of the tumors were easily visualized.

CHARLES G. SUTHERLAND, M.D.

Studies of Diseases of the Lymphoid and Myeloid Tissues. II.—Plasmacytomata and Their Relation to Multiple Myelomata. Henry Jackson, Jr., Frederic Parker, Jr., and James M. Bethea. *Am. Jour. Med. Sci.*, February, 1931, CLXXXI, 169.

The authors have rather thoroughly reviewed the literature on multiple myelomas, and have added five case reports to substantiate their belief that multiple myelomas of the plasma-cell type at least should be classed among the malignant lymphomas. That the disease in its classical form is largely limited to the bones does not militate against such a view, when one considers the marked variation of the disease pictured and the gradual manner in which the cases blend into each other.

In the first case cited, a plasmacytoma of the tonsil was removed eight years before generalized bone involvement could be detected, although for fully seven years the process was spreading through the lymphoid system, as successive lymph nodes were involved. The histology of the lymph nodes and bone lesions at autopsy were identical.

In the second case, it is difficult to say whether the lesions appeared first in the bones or in the lymph nodes, although a lesion in a lymph node first brought the patient to the hospital.

The third case was, again, a plasmacytoma, with no bone lesions, but sufficient time had not elapsed since the discovery of the primary lesion.

ROE J. MATER, M.D.

TUMORS (THERAPY)

Roentgen Irradiation of Malignant Tumors of the Pharynx. F. R. Nager. *Schweiz. med. Wchnschr.*, Feb. 28, 1931, LXI, 212, 213.

The author has followed the technic of Regaud and Coutard in the irradiation of fifty patients who had malignant tumors of the pharynx. A filtration of from 1 to 3 cm. of copper was used, and a focal skin distance of from 60 to 100 centimeters. Treatment was given twice daily through several ports, and the total dose varied from 50 to 150 S.E.D. Rather severe local reactions were sometimes encountered. The results appeared to be favorable, but a long enough period has not elapsed from the time the treatment was first instituted to permit the author to draw final conclusions.

Several case reports are given.

H. C. OCHSNER, M.D.

Radiotherapy in the Treatment of Uterine Fibromyomas. Jackson W. Landham. *Jour. Florida Med. Assn.*, October, 1930, XVII, 171.

The great majority of uterine fibroids in this country are removed surgically, while

many European gynecologists refer such patients for radiation. During the last seven years at St. Luke's Hospital (New York), according to Wood, 1,443 fibromyomas were removed surgically and only twenty such patients were referred for radiotherapy. Under the proper classification of fibromyomas, the treatment should be either observation, operation, or radiation. Small symptomless fibroids discovered in routine pelvic examinations may be kept under observation. Fibromyomas complicated by active pelvic inflammatory disease should be treated surgically, as should those associated with pain, those that are large, hard, or degenerating, those complicated by malignancy of the body of the uterus, and those producing pressure symptoms interfering with the function of the bladder or rectum. With these exceptions, practically all fibromyomas will respond satisfactorily to radiation. The X-ray is advocated in preference to radium because the patient is ambulant, there is usually no post-irradiation sickness, and it is more economical.

The author's technic is to give an erythema dose over the posterior pelvis at one sitting, at 180 K.V., 50 cm. distance, with $\frac{1}{4}$ mm. copper and 2 mm. aluminum. The anterior aspect is divided into two areas and the treatment is repeated in four weeks. Usually two such series are required to produce a menopause, but in patients under 40 years of age additional treatments may be required.

W. W. WATKINS, M.D.

The Suprarenal and Tumor Growth. William H. Woglom. *Am. Jour. Cancer*, April, 1931, XV, 704-706.

The author injected suprarenal extract from rabbits who had been inoculated with carcinoma 63 and sarcoma 180 into mice bearing these strains, and also suprarenal extract from normal rabbits. No demonstrable inhibitory effect was noted in either instance. He concludes, therefore, that the treatment of human patients with preparations of the suprarenal gland becomes an "idle and indefensible experiment."

JOHN R. CARTY, M.D.

The Diagnosis and Treatment of Lymphosarcoma of the Upper Air and Alimentary Passages. E. Luscher and H. Scartazzini. *Schweiz. med. Wchnschr.*, Feb. 28, 1931, LXI, 193-201.

After a review of 13 cases of lymphosarcoma in the regions of the pharynx, the author concludes that the treatment of these tumors belongs in the domain of radiotherapy. He feels that they should be considered apart from other sarcomatous lesions. Sixty per cent of 11 cases followed for a period of from six months to five years were free of symptoms or recurrence. These results show that the viewpoint that radiotherapy produces only temporary results is not justified. Most of the cases described were treated with radium at a distance, although in some cases radium was inserted directly into the tumors. In these, radium and X-ray therapy were combined.

H. C. OCHSNER, M.D.

Choriomas. Henry Schmitz. *Am. Jour. Obst. and Gynec.*, February, 1931, XXI, 256.

Tumors of the chorion may be benign or malignant. The benign growths comprise the simple hydatid mole or chorioma simplex and the invasive hydatid mole or chorioma accreta. The malignant group includes the typical malignant chorionepithelioma and the atypical malignant chorionepithelioma. The diagnosis is made from the symptoms, history, tissue examination, and hysterossalpingography, although this must be employed with caution, due to the possibility of forcing chorion through the tubes. The Aschheim-Zondek test is of some differential value.

The author reports 8 cases of chorionepithelioma. Two cases in which radium was introduced into the uterus and roentgenotherapy was employed externally have both remained well, 13 and $2\frac{1}{2}$ years, respectively. Three cases in which roentgenotherapy was employed as a post-operative measure have all remained well 2 years, $1\frac{1}{2}$ years, and 1 year, respectively. One patient upon whom roentgenotherapy was used to treat metastases to the

brain and elsewhere died in three months. Two patients were operated upon, with no post-operative treatment; one of these died 19 days after the operation, and one has remained alive and well for 1½ years.

The author concludes that irradiation alone or as a post-operative measure is definitely indicated in these cases. Similar observations on the benefit derived from irradiation have been reported by Naujoks, Gordon, Szathmary, Loebe, Klein, and others.

JACOB H. VASTINE, M.D.

Difficulties in the Radiation Therapy of Internal Malignant Tumors. E. Hayer. *Strahlentherapie*, 1931, XL, 50.

The author emphasizes the difficulties usually encountered in the radiation therapy of internal malignancies, and relates the history of a case illustrating this fact. A man, 50 years of age, came to the clinic in September, 1929, complaining of pain in the region of the stomach and saying that he had lost thirty pounds in weight during the last year. X-ray examination of the gastro-intestinal tract was negative. A tumor was, however, suspected in the gall-bladder region. Following the application of roentgen rays of short wave length in fairly high doses, there was a period of considerable relief, lasting about six months. The patient returned then to the clinic in very poor general condition; roentgenograms of the chest showed metastatic carcinoma of the lungs. An autopsy revealed a necrotic carcinoma at the papilla of Vater, with extensive metastases to the liver and lung.

ERNST A. POHLE, M.D., Ph.D.

Results of Irradiation Therapy of Malignant Tumors in the Year 1930. Hans R. Schinz. *Röntgenpraxis*, March 1, 1931, III, 202.

Following the example of the Radiumhemmet, the result of irradiation therapy of malignant tumors in the Roentgen Institute of the University of Zurich is published. This not only includes the cases treated during the year but also the follow-up statistics of cases treated in former years. The author suggests that every clinic or institute should follow this

plan in order to collect large groups of statistics. Skin and gynecologic carcinomas are not treated in the author's institute, but in the respective clinics. The statistics appear complicated because not only cures are reported but also palliative results. Palliation is unfortunately under-valued by the surgeons, but incurable cases of carcinoma may often be markedly benefited. Pre-operative irradiation is the method of choice, but is not always possible.

Two hundred thirty cases of malignant tumors are reported. Of these, 53 were symptom-free for one or more years; 9 were locally symptom-free, but had metastases; 12 were symptom-free, but had a recurrence and again became symptom-free or were improved; 27 were improved or non-progressive; 35 showed no improvement, and 25 are still under treatment. Of 39 cases of malignant tumors admitted to the Surgical Department, 28 were referred to the Radiological Department for irradiation therapy.

H. W. HEFKE, M.D.

The Question of Roentgen Therapy in Brain Tumors. J. Heinismann and L. Czerny. *Strahlentherapie*, 1931, XL, 302.

The authors have analyzed the cases of brain tumors observed in their clinic, with the exception of tumors in the region of the sella turcica, and present the following conclusions. In glioma of the brain, which, according to the literature, is highly susceptible to roentgen rays, the results obtained by X-ray therapy are not so good that it is permissible to irradiate without previous operation. X-ray therapy is indicated only in the afibrillar type of glioma, either following operation for prophylactic purposes or as a trial in inoperable cases.

Inoperable malignant brain tumors, primary as well as metastatic, very often respond well, temporarily, to roentgen rays. The treatment prolongs the life and very often the patient may return to work. A certain percentage of the good results seen in cases of so-called brain tumor without operative control is due, in the authors' opinion, to the fact that tumors were not actually present, but a serous meningitis. Improvement in cases in which

the tumor itself does not show any changes following irradiation are not due to an inhibitory effect of roentgen rays on the choroidal plexus, as assumed by Marburg and Sgalitzer. An early reaction following treatment cannot safely be excluded by using the fractional dose method. The best precaution is a decompression. This should be carried out not only to relieve pressure but also as an exploratory operation.

ERNST A. POHLE, M.D., Ph.D.

ULTRA-VIOLET LIGHT .

Antigenic Power of Ultra-violet-irradiated Tetanus Toxin. Emerson Megrail and Henry Welch. *Proc. Soc. Exper. Biol. and Med.*, February, 1931, XXVIII, 494.

The authors observed that an ultra-violet irradiation of two minutes with the "C" carbons failed to destroy the tetanus toxin, as one-half of the inoculated animals developed late tetanus. A further irradiation of two minutes, however, completely destroyed the toxin. Subsequently, the guinea pigs were each given five subcutaneous injections of one minimum lethal dose of irradiated toxin, at intervals of six or seven days. Three weeks later they were inoculated with freshly titrated toxin of from 1 to 10 minimum lethal doses, and no signs of tetanus developed.

J. N. ANÉ, M.D.

The Influence of the Wave Length in the Irradiation of Ergosterol. E. Kisch and T. Reiter. *Strahlentherapie*, 1931, XXXIX, 452.

In 1927, the authors exposed milk to ultra-violet rays. If the radiation extended below 2,800, a disagreeable odor developed in the milk. Considering this experience, they carried out studies with ergosterol in the form of 0.5 per cent solution in olive oil. This was irradiated with a quartz mercury vapor lamp, either with the entire spectrum or when cut off at 2,800 Ångströms. In the first case, the absorption spectrum showed a maximum at 2,450 and 2,700 Ångströms. If the irradiation was continued, these maxima became weaker and new absorption bands appeared at 2,800, 2,950,

and 2,700 Ångströms. These relations were quite different if the spectrum was used only as far as 2,800 Ångströms. After a few minutes' exposure, there appeared a definite absorption between 2,550 and 2,750 Ångströms. Continued irradiation increased this and the maximum effect was obtained after about two hours.

The solutions exposed under the two conditions mentioned above were used in animal experiments (rats on rickets diet); the ergosterol irradiated by the filtered spectrum of the quartz mercury vapor lamp could be given in much higher doses without producing toxic reactions. It was tested clinically in 51 tuberculous children, who gained about 8 per cent in weight under its administration during a period of several months.

ERNST A. POHLE, M.D., Ph.D.

Combined Treatment of Rheumatism with Infra-red and Ultra-violet Body Exposure. I. Gunzburg. *Strahlentherapie*, 1931, XXXIX, 798.

For the combined treatment of rheumatic patients, the author constructed an electric bath permitting the patient to lie down in comfort. The temperature easily reaches 70 degrees centigrade and is usually tolerated for from thirty to thirty-five minutes. During the bath the patient's head is cooled by wet towels. After fifteen minutes of rest, an exposure to the quartz mercury vapor lamp is the next procedure. A warm and cold douche or an alcohol rub finishes the treatment.

ERNST A. POHLE, M.D., Ph.D.

A Few Brief Remarks Concerning Ultra-violet Radiation. A. Rosset. *Strahlentherapie*, 1931, XXXIX, 794.

As early as 1907, the author compared the ultra-violet intensity available in the plains and mountains, using a very simple apparatus for the tests. They resulted in practically the same conclusions as obtained by Dorno, with very accurate instruments. It appeared that the ultra-violet intensity of the sun is much higher in the mountains than in the lowlands.

The difference decreases, the closer one gets to the summer season; it is appreciable only during the winter.

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The Effect of X-ray, Infra-red, and Ultra-violet Rays upon the Rutting Hormon. F. Ludwig and J. v. Ries. *Zentralbl. f. Gynäk.*, Jan. 17, 1931, LV, 137.

In an experimental study in mice, the authors discovered the following: (1) The X-ray has no effect upon the rutting hormon; (2) ultra-violet renders it ineffective; (3) infra-red increases its effectiveness to at least twice the normal strength, and (4) the ineffectiveness produced by ultra-violet may be eliminated by irradiation with infra-red.

Biologic Investigations Concerning the Transparency of Gypsum and Mica in the Ultra-violet Region. Tomoshige Takagi. *Strahlentherapie*, 1931, XL, 189.

Hausmann and Krumpel studied the transparency of gypsum and mica for the radiation emitted by a quartz mercury vapor lamp, with the spectrographic method. The author repeated these experiments on biologic objects, namely, blood agar and human skin. In confirmation of the results obtained by Hausmann and Krumpel, he found that mica does not transmit, biologically, effective ultra-violet radiation, while definite reactions were obtained from the rays passing through gypsum.

ERNST A. POHLE, M.D., Ph.D.

Concerning the Merits of Treatment Rooms for Mass Ultra-violet Irradiation. A. Lippmann and F. Dannmeyer. *Strahlentherapie*, 1931, XXXIX, 650.

In order to determine the dose per time unit received by a patient walking in a room flooded with ultra-violet light from a series of lamps, the authors fastened twenty pieces of slow photographic paper on various parts of the body. Following exposures for a definite time, the paper was fixed and the degree of blackening compared with an arbitrary scale. The results obtained suggest the best way of arranging the lamps in the treatment room:

It was, in this case, the grouping of four lamps in a circle of four meters diameter. Other tests showed that additional exposure to a Sol-luxlamp (radiant heat) did not improve the results obtained by ultra-violet light alone. The tests were checked with a cadmium cell; although there appeared to be quantitative differences, the principal conclusions were confirmed.

ERNST A. POHLE, M.D., Ph.D.

The Combined Effect of Roentgen and Ultra-violet Light. Karl Steiner. *Strahlentherapie*, 1931, XXXIX, 500.

The cornea of salamander larvæ was exposed to ultra-violet and roentgen rays in various combinations. In all cases the roentgen reaction was enhanced by additional ultra-violet exposure. This cannot be interpreted, however, as a cumulation, in the sense of a true sensitization, but merely as a non-specific co-addition.

ERNST A. POHLE, M.D., Ph.D.

The Effect of the Ultra-violet, Sun, and Sky Light on the Thyroid of Rats, with Consideration of the Basal Metabolism Rate. Walther Bergfeld. *Strahlentherapie*, 1931, XXXIX, 245.

The histological changes in the thyroid of rats were studied following exposure of the animals to different parts of the spectrum. One group received radiation cut off at 3,500 Å.; another group received radiation cut off at 3,100 Å., and a third group received radiation as low as 2,600 Å. For control purposes some rats were kept in the dark. Since previous experiments carried out in different places revealed discrepancies in the results, animals were treated alike in Bern, Freiburg, and Berlin. The periods of observation in each group run from 21 to 42 to 63 days. In some cases, extracts were made from the skin of the rats exposed to ultra-violet light of long or short wave length, and then injected into the animals kept in the dark. All rats, regardless of the place where they were treated, if they were kept in the dark or had been exposed to radiation cut off at 3,100 Å., showed identical

histological changes in the thyroid. They consisted of an increase in the follicles, lack in colloid, and an extremely high follicle epithelium. These findings could not be correlated with the basal metabolic rate. In animals treated by ultra-violet rays down to 2,800 Å., no similar changes could be observed. Those rats which had been kept in the dark and then injected with skin extract obtained from animals exposed to short ultra-violet rays showed a definite improvement in the histological picture, as compared with the uninjected rats or rats which had been injected with extract obtained from animals exposed to ultra-violet rays of long wave length.

The author believes that he has proven, therefore, that the described changes in the thyroid of rats can be prevented or decreased by ultra-violet rays between from 3,100 to 2,800 Å. The effect takes place by the so-called humoral route.

ERNST A. POHLE, M.D., Ph.D.

The Electrophysiologic Changes in the Skin Following Exposure to Ultra-violet Light. Philipp Keller. *Strahlentherapie*, 1931, XXXIX, 320.

Immediately following exposure to ultra-violet light, there are no definite changes in the electric reaction of the skin. As soon as the erythema appears, that is, from two to five hours following the exposure, there is a slight increase of the polarization. Sometimes one also finds a slight change of the basic potential towards the positive. At the height of the erythema, the polarization is more or less decreased and the basic potential considerably more positive. This must be interpreted as an injury to the epidermic membrane. The tonus potential is also decreased and the intensity of the Tarchanoff reflexes diminishes. In other words, the parasympathetic tonus and the parasympathetic irritability are definitely decreased in the erythema area. With the disappearance of the erythema, the polarization increases while the potential still remains positive. The tonus potential decreases further and occasionally the Tarchanoff reflexes can

not be released. A number of curves illustrate the findings.

ERNST A. POHLE, M.D., Ph.D.

International Congress for Pediatrics. Richard Hamburger. *Monatschr. f. Kinderheilk.*, Feb. 23, 1931, XLIX, 212-219.

The biological effect of direct and indirect ultra-violet irradiation was discussed extensively by authorities from various parts of the world. The discussion was opened by A. F. Hess, of New York, who set forth the uses, dosage, etc., of irradiated ergosterol. H. J. Gerstenberger, of Cleveland, reported his findings in the examination of wet nurses who were given the substance for the purpose of combating rickets in their nurslings. Other speakers were Gorter, of Leyden; György, of Heidelberg; Lesne and Celment, of Paris; Medowikoff, of Leningrad; Spyropoulos, of Athens, and others. They all discussed the effect of irradiated ergosterol and similar substances; also direct irradiation with ultra-violet light upon rickets, and reported good results.

The Ultra-violet Absorption of Proteins. Heinrich Guthmann, Kurt Schwerin, and Fritz Stähler. *Strahlentherapie*, 1931, XXXIX, 401.

Clinical and biological observations suggest that proteins are important factors in the mechanism of the light erythema. A number of amino acids were analyzed by the authors as to their ultra-violet absorption. From the results obtained in these acids in biologic concentration, the chemical compositions of albumin, globulin, and fibrin were calculated. It appeared that there were two maxima of absorption in the synthetic mixture located at 3,000 and 2,500 Ångströms. A comparison of the theoretical curves with the absorption curves of serum and chicken albumin showed that tyrosin, phenylalanin, and glutamin acid are the strongest absorbers. Further studies on compounds belonging to the propion acid group demonstrated the fact that molecular weight does not influence the absorption phenomena but that there is a definite de-

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pendence on the stereochemical structure. Organic compounds belonging to the following groups effected the absorption in the order in which they are named: Aldehyde group (most effective), amino group, COOH group, and alcohol group.

Forty-seven graphs and fifteen tabulations illustrate the results.

ERNST A. POHLE, M.D., Ph.D.

Medication and Ultra-violet Rays. Gr. Roskin. *Ztschr. f. Immunitätsforsch. u. exper. Ther.*, January, 1931, LXIX, 473.

This is an experimental study in mice, in which the author sought to determine the combined effect of ultra-violet rays and medication. The mice were infected with tincture equiperdum. Examination revealed that the serum of mice treated with ultra-violet rays contained a particular factor *A*, which intensified the therapeutic effect of neosalvarsan.

This factor *A* disintegrates if the serum is kept at a temperature of 56° C. for half an hour; it also disintegrates if the serum is exposed to ultra-violet radiation. Absorption of factor *A* from the serum may be accomplished with kaolin. Observation showed participation of the active mesenchyma of the skin and the entire reticulo-endothelial system in the production of factor *A*. The serum of irradiated, splenectomized mice contains little factor *A* or none at all.

The Formation of a Compound from Histidin under Ultra-violet Radiation, with Effects Similar to Those of Histamin, and the Significance of this Process for the Light Erythema. F. Ellinger. *Strahlentherapie*, 1930, XXXVIII, 521.

Histidin in solution exposed to ultra-violet rays is partly transformed into histamin, which produces contractions in the surviving intestines of guinea pigs. The wave length of the light does not seem to be of influence as long as the radiation belongs to the ultra-violet

region. If the histidin is dissolved in serum and then irradiated, the exposed solution also produces a contraction of the intestines. The skin of small pigs was exposed to ultra-violet rays and pieces excised in the erythema area. Extracts of the excised skin also produced contraction of the intestines in several instances. As to the mechanism of the skin erythema, the author believes that, following exposure, a histamin-like compound is formed from histidin in the upper layers of the epidermis. This causes the first reddening and the histologic picture of leukocyte grouping in the blood vessels. Depending upon the type of radiation and its intensity, injurious effects on the prickle-cells may be added. The substance released by these cells increases the erythema.

ERNST A. POHLE, M.D., Ph.D.

Biology and Practical Use of the Threshold Erythema for Ultra-violet Rays. V. Wucherpfennig. *Strahlentherapie*, 1931, XL, 201.

This article is a detailed report of the author's extensive studies concerning the skin erythema, following exposure to ultra-violet rays. He has used the so-called threshold value of the erythema, and it was surprising how small a difference in the dose applied could be recognized with this procedure. The simple apparatus is described and sketched. The relations between threshold erythema and age, complexion, and sex are related; the effect of pressure during exposure, as well as that of the wave length, has also been considered. A very characteristic and almost constant ratio between the reactions was seen in persons who had been irradiated before, either with the mercury vapor lamp or with the sun. A pathologic hypersensitivity to light should be diagnosed only if irradiation of hitherto unexposed skin areas is followed by the typical symptoms of a light dermatosis.

ERNST A. POHLE, M.D., Ph.D.

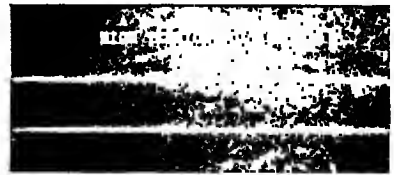
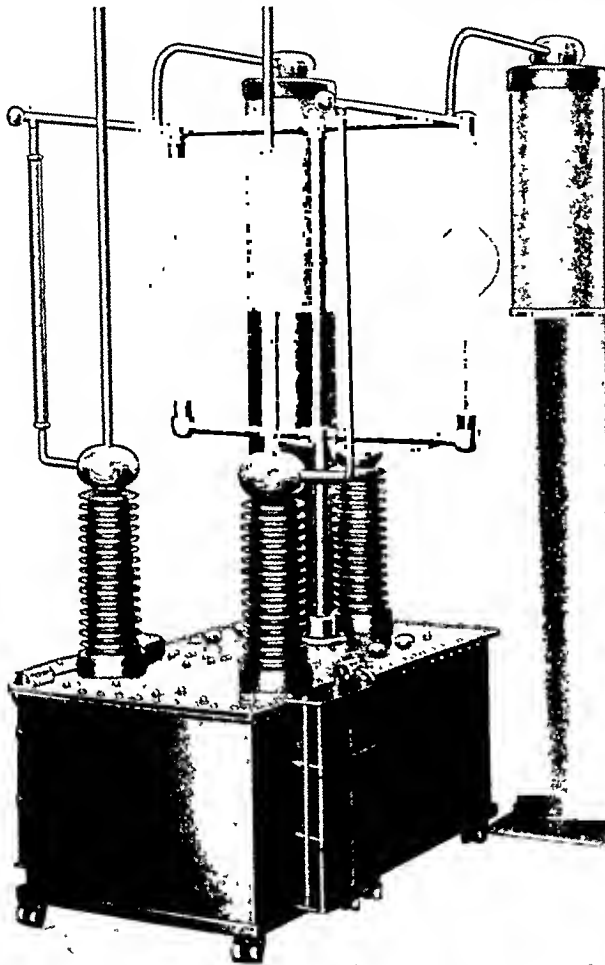
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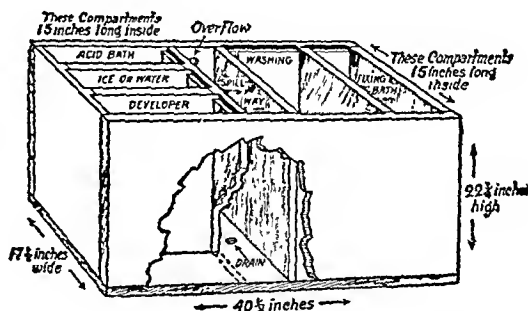
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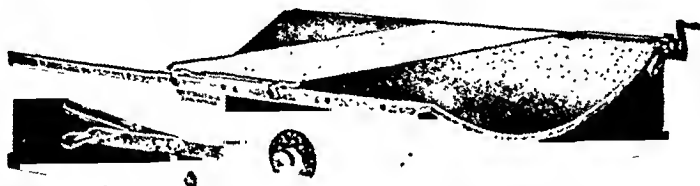
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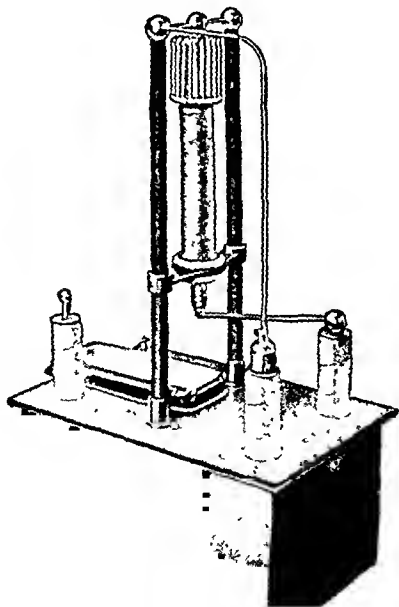
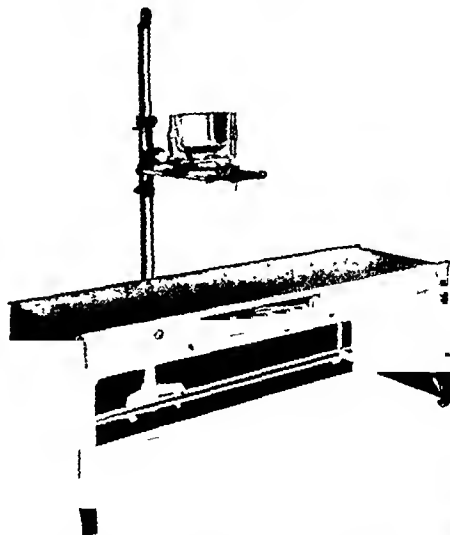
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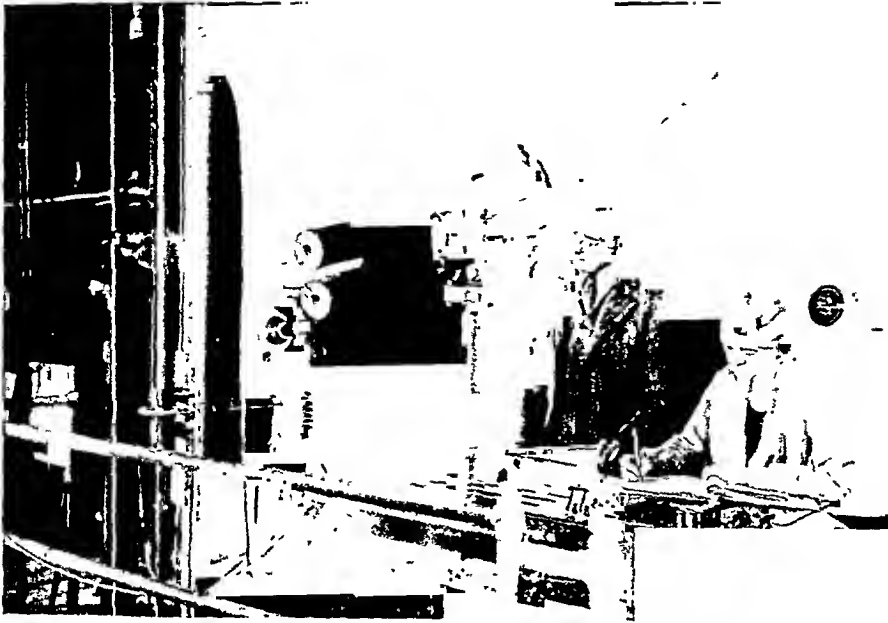
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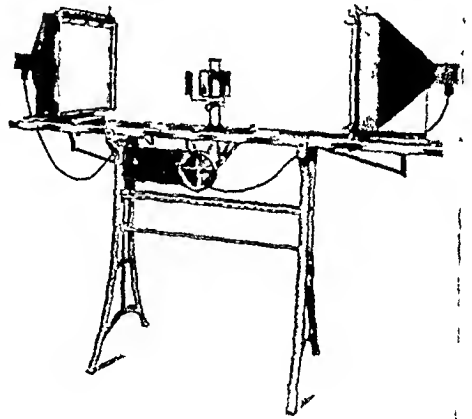


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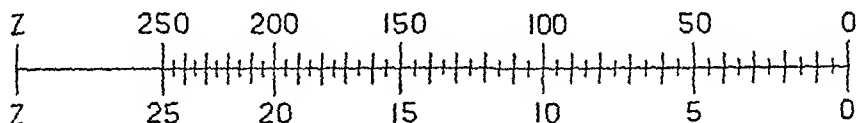
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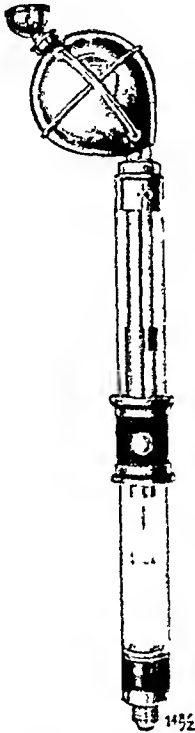
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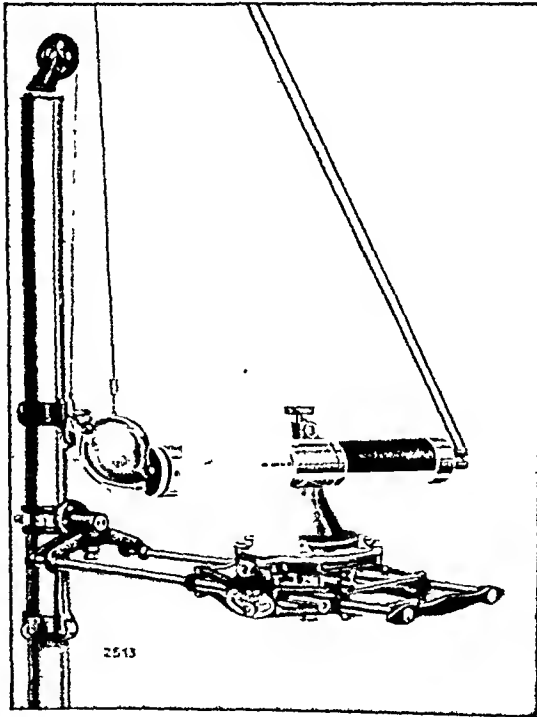
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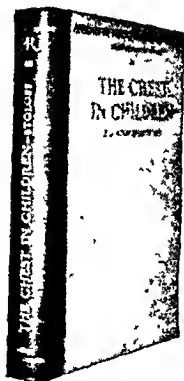
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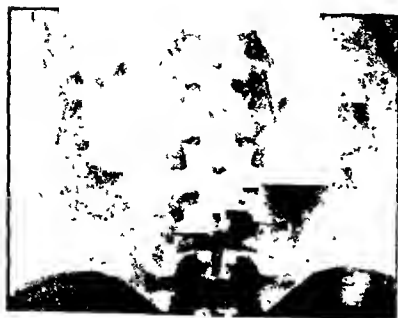
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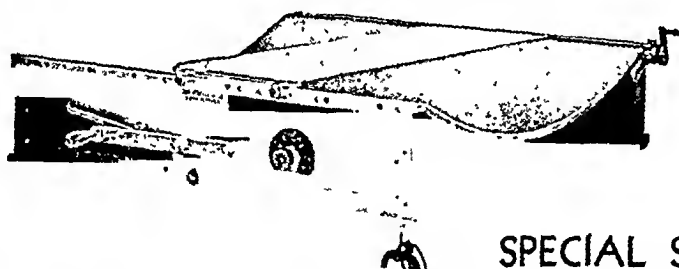
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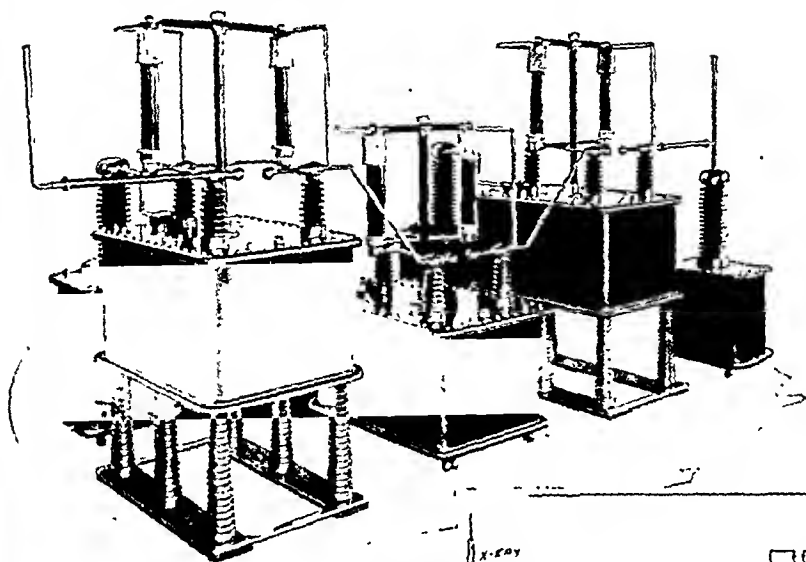
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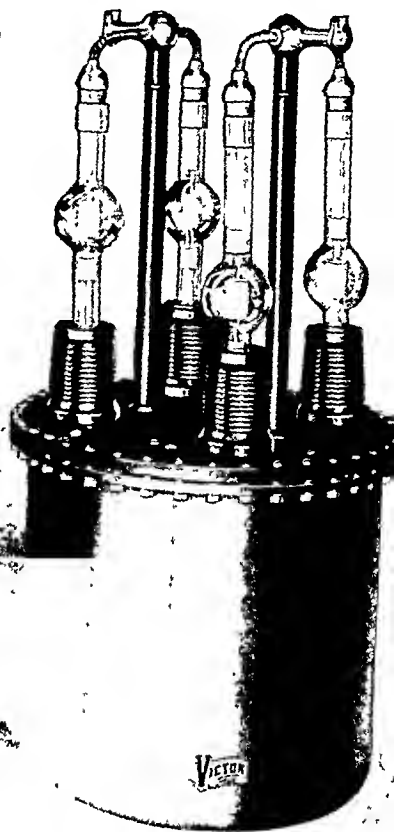
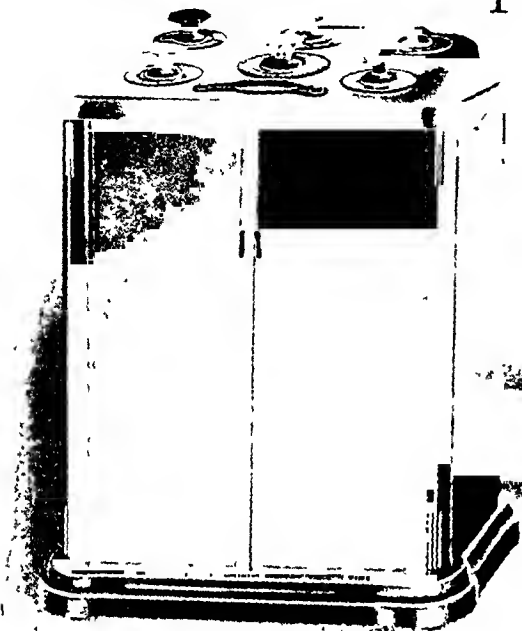
A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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No. 2

PRIMARY CARCINOMA OF THE FEMALE EXTERNAL GENITO-URINARY ORGANS TREATED WITH RADIUM AND ROENTGEN RAYS¹

By HARRY H. BOWING, M.D.

Section on Therapeutic Radiology, The Mayo Clinic, ROCHESTER, MINNESOTA

IT is not uncommon to see a brilliant local response to radium therapy of primary carcinomatous lesions of the female external genito-urinary organs. This observation prompted a review of the total number of these cases seen in the Section on Therapeutic Radiology of The Mayo Clinic. The study includes all patients with the conditions under consideration, who were treated from 1915 to 1929, inclusive, a total of 95. Radium therapy was first employed at The Mayo Clinic for carcinoma of the vulva in 1915.

Rentschler, of the Clinic, reported a similar study recently. In his review he included only cases seen on the surgical service between 1907 and 1927. The present report includes 38 cases studied by Rentschler. This number was referred to the Section on Therapeutic Radiology from the surgical service.

The incidence of carcinoma involving the external female genitalia has been recorded by various authors. Schwarz gave the incidence as 1.38; Virchow reported 1.35 or 1.40; Gurtt gave the incidence of 1.48; Taussig gave 1.20. Brady, reporting

statistics from Johns Hopkins Hospital, recorded 19 cases of epithelioma of the vulva and 756 cases of carcinoma of the cervix, or a ratio of 1.397. In two of the cases the growth was of the urethra. In The Mayo Clinic the ratio based on histologic study was 1.25. Clark and Norris reported that among 1,119 specimens of newgrowths in the Gynecologic Laboratory of the University of Pennsylvania there were 30 carcinomas of the vulva. There was a total of 1,049 carcinomas in the same laboratory; that is, carcinoma of the vulva represented 2.9 per cent of all gynecologic carcinomas there. Ewing stated that carcinomas of the vulva are not rare; they form 10 per cent, according to Gurtt, of all carcinomas in women.

The age incidence in the group on which this paper is based is almost identical to that reported by Rentschler (Table I). Sixty-six patients, or nearly 70 per cent, were between the ages of forty-five and sixty-nine years, the average age being 57.24 years. The youngest patient was thirty years of age and the oldest eighty-five years.

The civil state is recorded in Table II. The average number of pregnancies was four. The number of multiparæ in this

¹Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, December 1-3, 1930.

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TABLE II.—INCIDENCE OF PREGNANCY

Civil state	Cases	Per cent	Pregnancies											None	Not recorded
			1	2	3	4	5	6	7	8	9	10	11		
Married	91	95.78	14	16	7	10	7	5	4	3	3	1	2	17	2
Single	4	4.21												4	
Total	95	99.99	14	16	7	10	7	5	4	3	3	1	2	21	2

TABLE III.—GRADE OF LESION IN RELATION TO ITS SITUATION

Microscopic diagnosis	Cases	Labia majora		Labia minora		Urethra		Clitoris		Vestibule		Bartholin gland	
		Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
Epithelioma not graded	1					1	6.25						
Squamous-cell epithelioma, graded 1	3	2	4.54			1	6.25						
Squamous-cell epithelioma, graded 2	28	19	43.18	2	100	4	25.00	3	75				
Squamous-cell epithelioma, graded 3	19	13	29.54			5	31.25	1	25				
Squamous-cell epithelioma, graded 4	11	7	15.90			4	25.00						
Basal-cell epithelioma	1	1	2.27										
Adenocarcinoma, graded 2	2	1*	2.27									1	100
Inflammatory tissue	2	1	2.27			1	6.25						
No biopsy	28	19	30.15			8	33.33			1	100		
Total	95	63	66.31	2	2.10	24	25.26	4	4.21	1	1.05	1	1.05

*Papillary adenocarcinoma graded 2 in a cyst.

Bonney, in reporting 58 cases of carcinoma of the vulva, and 19 of leukoplakic vulvitis, among patients admitted to the Middlesex Hospital and Chelsea Hospital for Women in the last ten years, stated that in none of their cases was there any history or sign of antecedent syphilis, nor could evidence of the presence of the *Treponema pallidum* be obtained by histologic methods. Graves has expressed the opinion that leukoplakia and kraurosis (white vulvitis) invariably result from chronic irritation, that they represent the result of an irritating process, and that carcinoma of the vulva is a good illustration of the relationship between irritation and malignant neoplasia.

MacKee has stated that leukoplakia is a dangerous pre-epitheliomatous lesion. Tausig holds that leukoplakic vulvitis is undoubtedly the most frequently encountered causal factor of carcinoma of the vulva. He

states further that there are other conditions to be reckoned with, such as syphilis, acuminate warts, and trauma. In a series of 23 cases which he saw, syphilis occurred in two, trauma in two, condyloma acuminatum in one, leukoplakic vulvitis in fourteen, and accompanying lesions of uncertain nature in four. He expressed his feeling that this incidence justifies the classification of leukoplakia as a precancerous lesion. Further on in the chapter on carcinoma of the vulva, he mentioned that Perruchet found three cases out of 19 in which leukoplakia had not progressed to the stage of carcinoma, and he concluded, as also did Petit, that the leukoplakia is just the first stage of carcinoma and that sooner or later in every case in which this form of vulvitis has occurred, carcinoma is certain to develop. In commenting on these conclusions, Tausig did not care to hold to such all-inclusive

TABLE I.—INCIDENCE BY AGE

Age, years	Cases	Per cent
30 to 34	5	5.26
35 to 39	5	5.26
40 to 44	5	5.26
45 to 49	11	11.57
50 to 54	15	15.78
55 to 59	13	13.68
60 to 64	15	15.78
65 to 69	12	12.63
70 to 74	7	7.36
75 to 79	4	4.21
80 to 84	2	2.10
85 to 89	1	1.05
Total	95	
Average age 57.24		

group was 17, or 19.10 per cent; the corresponding values given by Taussig and by Gicsecke were 18 per cent and 43 per cent, respectively. Berkeley and Bonney, in a similar study, reported that 58.6 per cent were married; 25.8 per cent were widows, and 15.6 per cent were single women. Sterility occurred in 48.2 per cent of their cases, and the average number of pregnancies was seven.

The frequency with which various parts of the vulva are involved was found by Rothchild, who studied 395 carcinomas of the vulva, to be as follows: clitoris, 62; clitoris and labia of one side, 41; clitoris and labia of both sides, 21; labia majora, 105; labia minora, 35; labia majora and minora, 29; tissue about the urethra, 6; posterior commissure, 11, and Bartholin's gland, 17. Owing to the extent of the primary lesion when first seen by the surgeon and radiologist it is in many cases impossible to determine the exact site of the initial involvement; however, the situation of the primary tumors in the cases reviewed for this study is given in the last line of Table III. Ederle tabulated 677 carcinomas of the vulva and pointed out the marked predisposition of the clitoris to malignant change. This is especially noticeable when the small surface occupied by this structure is considered. In Ederle's series the clitoris was affected in

109 cases. In this study the cases recorded as occurring primarily in the tissues of the external urinary meatal region were included. Cabot stated that probably not more than twenty-five or thirty critically studied cases of primary carcinoma arising from the mucous membrane of the urethra have been reported. In many of the cases in this study infiltration was extensive when first seen. Therefore, the possibility of the tumor arising in the para-urethral ducts, in peri-urethral tissue, in the vagina, or in the bladder must be taken into account.

The first symptoms noticed by the patients can be grouped as follows: tumor was noted in 45 cases (47.36 per cent); ulcer, in 36 cases (37.89 per cent); discharge, in eight cases (8.42 per cent); urinary symptoms in three cases (3.15 per cent), and pain, in two cases, (2.10 per cent). In one case (1.05 per cent) the first symptom was not recorded.

In 52 cases it was possible to estimate the interval of time between the onset of the first symptom and the first visit to the physician. The shortest interval was one week; the longest interval was thirteen years; the average, about eighteen months.

Pruritus was the most common associated local condition; it was recorded in 37 cases (38.94 per cent). Ewing expressed the opinion that the associated parakeratosis and infiltration of the corium with round cells in pruritus are distinctly favorable to the development of epitheliomatous lesions of the vulva. At times the itching is intense. Scratching may result in repeated trauma, and in some cases repeated or chronic irritation is a factor in the development of malignant disease. Berkeley and Bonney reported that 36 per cent of their patients who had carcinoma complained of pruritus. Associated systemic disease was not common in this group. One case each of diabetes, syphilis, and nephritis occurred, or a percentage of 1.05 each. Berkeley and

TABLE II.—INCIDENCE OF PREGNANCY

Cases	Per cent	Pregnancies											None	Not recorded
		1	2	3	4	5	6	7	8	9	10	11		
91	95.78	14	16	7	10	7	5	4	3	3	1	2	17	2
4	4.21												4	
95	99.99	14	16	7	10	7	5	4	3	3	1	2	21	2

TABLE III.—GRADE OF LESION IN RELATION TO ITS SITUATION

Microscopic diagnosis	Cases	Labia majora		Labia minora		Urethra		Clitoris		Vestibule		Bartholin gland	
		Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
oma not graded	1					1	6.25						
ous-cell epithelioma, graded 1	3	2	4.54			1	6.25						
ous-cell epithelioma, graded 2	28	19	43.18	2	100	4	25.00	3	75				
ous-cell epithelioma, graded 3	19	13	29.54			5	31.25	1	25				
ous-cell epithelioma, graded 4	11	7	15.90			4	25.00						
cell epithelioma	1	1	2.27										
carcinoma, graded 2	2	1*	2.27									1	100
inflammatory tissue	2	1	2.27			1	6.25						
opsy	28	19	30.15			8	33.33			1	100		
al	95	63	66.31	2	2.10	24	25.26	4	4.21	1	1.05	1	1.05

*illary adenocarcinoma graded 2 in a cyst.

y, in reporting 58 cases of carcinoma vulva, and 19 of leukoplakic vulvitis, g patients admitted to the Middlesex ital and Chelsea Hospital for Women last ten years, stated that in none of cases was there any history or sign of edent syphilis, nor could evidence of resence of the *Treponema pallidum* be med by histologic methods. Graves has essed the opinion that leukoplakia and rosis (white vulvitis) invariably result n chronic irritation, that they represent result of an irritating process, and that cinoma of the vulva is a good illustration the relationship between irritation and liguant neoplasia.

Mackee has stated that leukoplakia is a ugerous pre-epitheliomatous lesion. Taus- g holds that leukoplakic vulvitis is un- oubtedly the most frequently encountered usal factor of carcinoma of the vulva. He

states further that there are other conditions to be reckoned with, such as syphilis, acuminate warts, and trauma. In a series of 23 cases which he saw, syphilis occurred in two, trauma in two, condyloma acuminatum in one, leukoplakic vulvitis in fourteen, and accompanying lesions of uncertain nature in four. He expressed his feeling that this incidence justifies the classification of leukoplakia as a precancerous lesion. Further on in the chapter on carcinoma of the vulva, he mentioned that Perruchet found three cases out of 19 in which leukoplakia had not progressed to the stage of carcinoma, and he concluded, as also did Petit, that the leukoplakia is just the first stage of carcinoma and that sooner or later in every case in which this form of vulvitis has occurred, carcinoma is certain to develop. In commenting on these conclusions, Taussig did not care to hold to such all-inclusive

TABLE I.—INCIDENCE BY AGE

Age, years	Cases	Per cent
30 to 34	5	5.26
35 to 39	5	5.26
40 to 44	5	5.26
45 to 49	11	11.57
50 to 54	15	15.78
55 to 59	13	13.68
60 to 64	15	15.78
65 to 69	12	12.63
70 to 74	7	7.36
75 to 79	4	4.21
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are transmitted by contact from the labia of one side to those of the other. Graves has stated that the diagnosis from inspection may be either simple or difficult. A papillary or ulcerated lesion situated on a leukoplakic or sclerotic base is almost always a carcinoma or a precancerous growth. In different stages the appearance of the lesions resembles that in numerous diseases, such as lupus, condyloma, esthiomene, elephantiasis, granuloma inguinale, and metastatic carcinomatous processes; however, the diagnosis is readily made by biopsy. The cases included in this study were grouped into five classes: advanced, modified, borderline, recurring, and early; the percentages of each are given in Table IV. They could also be grouped according to the size of the primary lesion, together with notation as to whether or not there was inguinal nodular enlargement or involvement. When the primary region of involvement measured less than 2 cm., it was considered small; if it measured more than 2 cm. but not more than 4 cm., it was grouped as medium, and if it was larger than 4 cm., it was grouped as large.

The size only of the primary lesion does not determine its classification as advanced, modified, borderline, or recurring. For example (Table IV) in the advanced group, 31 cases (65.95 per cent) were large lesions; ten (21.27 per cent) were lesions of medium size, and six (12.76 per cent) were small lesions. In the modified group the percentage of large lesions was about the same as in the advanced group but the percentages of medium and small lesions were reversed. The numbers of borderline, recurring, and early lesions may be too small for comparison. In the recurring cases, the lesions were either medium or small, probably because the patients understood only too well the significance of delay as soon as it was evident that the tumor had returned. In six cases (75 per cent), the early lesions were

small. More than half of the total number of patients, when first seen at The Mayo Clinic, had large primary lesions: in 18 (18.94 per cent) of the cases the lesions were medium, and in 23 (24.21 per cent), they were small.

The size of the primary lesion, as well as the duration of the disease and the type of pathologic change, influences the regional and distant metastatic involvement. In Rentschler's thesis is a brief sketch of the anatomy of the lymphatic structures of the vulva. Rentschler gave a summary of Crossen's views as follows:

(1) From carcinoma of the labia majora or minora all the lymphatic distribution in the early stages is likely to be to the inguinal nodes; (2) this distribution may extend not only to the side on which the lesion is situated but also to the opposite side; hence the nodes on both sides should be removed, and (3) in carcinoma of the clitoris early distribution to the glands inside the pelvis is probable.

In the cases with ulcerated lesions there is a possibility that the inguinal nodal enlargement may be due to the ulceration or secondary infection.

Schwarz found that the swollen inguinal nodes were invaded by carcinoma in only about half of his cases, and Dittrich stated that involvement of the lymph nodes occurs in about 50 per cent of the cases in the second six months of the disease. Evidently these tumors metastasize rapidly. The cases which form the basis of the present review do not furnish positive data in this regard; however, there were 17 cases in which abnormal nodal conditions were proved clinically and by examination of tissues (Table V). The incidence of clinically proved nodal enlargement in the 95 cases is given in the same table. It shows rather clearly that any method of treatment that did not take into account the inguinal nodes

statements. In a later study he reported 39 cases of a total of 76 (51.31 per cent) in which leukoplakic vulvitis occurred. Berkeley and Bonney, in their review, previously referred to, gave their opinion that leukoplakic vulvitis is an antecedent condition and the cause of carcinoma of the vulva. In their cases of carcinoma of the vulva that came to operation, as well as every case seen, leukoplakic vulvitis has always been present.

Taussig stated that simple kraurosis of the vulva is a chronic, atrophic condition, resulting in stenosis of the vaginal orifice, and that its lesions do not tend to undergo malignant degeneration; however, leukoplakic vulvitis with sclerosis, so-called leukoplakic kraurosis or kraurosis of Breisky, does occur as an etiologic factor in malignant disease of the vulva. Berkeley and Bonney wrote that they did not know of an instance in which kraurosis vulvæ had been associated with carcinoma of the vulva, and that in their opinion the two diseases are not related; in this way kraurosis vulvæ markedly differs from leukoplakic vulvitis. Tausig agreed with these authors that non-leukoplakic, or simple, kraurosis, is not associated with carcinoma of the vulva. Counsellor, in a recent paper, concluded that the relation of leukoplakia vulvitis to carcinoma is not definitely known and will be solved only when the cause of carcinoma is discovered.

It seems evident that, although these lesions are superficial and benign, they tend to malignant degeneration or change. Therefore, patients must be carefully observed at repeated intervals in order that radical surgical intervention may be instituted as soon as early changes have taken place. Locally applied medication, radium therapy, or roentgen therapy relieves the itching, and in some cases the leukoplakic vulvitis has been favorably influenced by radium or roentgen rays. However, MacKee has given the opinion that extensive leukoplakia is almost incurable by any method of treatment.

TABLE IV.—SIZE OF LESION IN RELATION TO CLASSIFICATION OF SEVERITY OF CASE

Classification			Large		Medium		Small	
	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
Advanced	47	49.47	31	65.95	10	21.27	6	12.76
Modified	29	30.52	20	68.96	3	10.34	6	20.68
Borderline	4	4.21	2	50.00	1	25.00	1	25.00
Recurring	7	7.36			3	42.85	4	57.14
Early	8	8.42	1	12.50	1	12.50	6	75.00
Total	95		54	56.84	18	18.94	23	24.21

Advanced: Small, medium, or large lesion with enlarged nodes (grossly or microscopically).

Modified: Previous treatment affecting lesion elsewhere.

Borderline: Small, medium, or large lesion without enlargement of nodes.

Recurring: Previous operation affecting lesion at The Mayo Clinic.

Early: Small lesion without nodal enlargement.

Resection of the internal pudic nerve under local anesthesia relieves the itching or the cause of the repeated scratching, a source of chronic irritation. Vulvectomy, as stated by Miller, is both prophylactic and curative.

In this review of 95 cases, leukoplakia was found to be recorded in five cases (Rentschler in his review of 71 cases reported five cases); kraurosis, in ten cases, and kerato-sis, in two cases. I feel reasonably certain these data are incomplete, and that in all likelihood the ten cases just mentioned (kraurosis) could be grouped as cases of leukoplakic vulvitis with sclerosis. In many of the advanced cases, leukoplakia may have been present but not recorded.

From a clinical standpoint there are two types of primary carcinoma of the vulva: (1) the evertting, fungating, papillary or medullary, and in some cases nodular, and (2) the invertting, infiltrating, or plaque-like lesions. In the advanced stages both types can be ulcerated, craters can be formed, and neighboring tissues can be undermined; usually these advanced lesions are associated with marked secondary infection. The growths are often multiple and apparently

TABLE VII.—TYPE OF TREATMENT IN RELATION TO GRADE OF PATHOLOGIC LESION

TABLE VII.—TYPE OF PRETREATMENT

Microscopic diagnosis	Excision of growth and											
	Cases	Per cent	Removal of inguinal nodes, radium and roentgen ray		Removal of inguinal nodes and radium		Radium and roentgen rays		Radium		Radium and roentgen rays	
			Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
Squamous-cell epithelioma not graded	1	1.49									1	100.00
Squamous-cell epithelioma, graded 1	3	4.47	1	33.33			1	33.33			1	33.33
Squamous-cell epithelioma, graded 2	28	41.79	4	14.28	3	10.71	3	10.71	12	42.85	2	7.15
Squamous-cell epithelioma, graded 3	19	28.35	3	15.78	1	5.26	3	15.78	3	15.78	5	26.31
Squamous-cell epithelioma, graded 4	11	16.41	2	18.18	3	27.27					2	18.18
Adenocarcinoma, graded 2	2	2.98							2	100.00		
Basal-cell epithelioma	1	1.49							1	100.00		
Inflammatory tissue	2	2.98									1	50.00
No biopsy	28	29.47									12	42.85
Total	95		10	10.52	7	7.36	7	7.36	18	18.94	23	24.21
											30	31.57

was applied in 37 cases (38.94 per cent); 53 patients (55.78 per cent) were not operated on.

The type of the treatment considered here has been described in another article (3), and the study revealed that 54 patients (56.84 per cent) received complete treatment, 23 (24.21 per cent) received prophylactic treatment, and 18 (18.94 per cent) received only limited treatment. In none of the cases was the treatment abandoned. The type of treatment has always been influenced by the extent of the local and distant involvement, general condition of the patient, and so forth.

Of late years more cases were referred to the Section on Therapeutic Radiology without surgical intervention. Table VIII shows to what extent this shift to irradiation has occurred. The headings are the same as those used in Table VI. The patients were grouped according to the year of their initial treatment. More than half (53) of the patients were treated either with radium only or with radium combined with roentgen rays. The table also shows that irradiation, even in early years, was thought

worthy of consideration in the treatment of these lesions, and as time passed the effectiveness was more apparent and wider use was made of it.

It was considered of interest to determine, if possible, if the grade of malignancy influenced the type of treatment. The same headings as those used in Table VI were used in Table VII. Since the tumors which were graded were about equally distributed between Grades 1 and 2 on the one hand, and Grades 3 and 4 on the other, it seems reasonable to assume that in the 28 cases (29.47 per cent) in which material was not available for grading and in which treatment was by irradiation only, the number of patients with high and with low grades of malignancy, respectively, would have been approximately equal. It seems rather evident that the grade of malignancy did not influence the type of treatment. However, in a general way I am confident that the members of the surgical staff at The Mayo Clinic fully appreciate the ultimately poor prognosis in cases graded 3 and 4, when operation only is employed.

TABLE V.—CONDITION OF LYMPH NODES

Condition		Bilateral enlargement of inguinal nodes		Unilateral enlargement of inguinal nodes		Nodes not enlarged		Size of nodes not recorded		Total	
		Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
By pathologic methods	Positive	3		4		2		1		10	
	Negative	1		1		1		4		7	
Clinically positive		44	46.31	16	16.84	15	15.78	20	21.05	95	99.99

TABLE VI.—TYPE OF TREATMENT IN RELATION TO SIZE OF LESION*

Size of lesion, cm.	Cases	Excision of growth and								Radium and roentgen rays		Radium	
		Removal of inguinal nodes, radium and roentgen ray		Removal of inguinal nodes and radium		Radium and roentgen rays		Radium					
		Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
Less than 2	23	2	8.69	2	8.69	3	13.04	7	30.43	2	8.69	7	30.43
2 to 4	18	4	22.22	3	16.16	1	5.55	2	11.11	4	22.22	4	22.22
More than 4	54	4	7.40	2	3.70	3	5.55	9	16.66	17	31.48	19	35.18
Total	95	10	10.52	7	7.36	7	7.36	18	18.94	23	24.21	30	31.57

*11 cases (11.57 per cent), no post-operative treatment to the primary lesion.

45 cases (47.36 per cent), no treatment to the secondary lesion.

lar regions would be decidedly inadequate.

Of the total of 67 tumors that were studied microscopically, 62 (92.53 per cent) were squamous-cell epitheliomas. Broders graded 61: 31 were graded 1 or 2 and 30 were graded 3 or 4. In this group, the number of neoplasms of low to moderately high grade of malignancy and the number of neoplasms of rather high grade of malignancy may be considered equally distributed. The grades of the lesions, in relation to their situation, is given in Table III, which has been referred to before.

The cases were grouped in six classes according to the method of treatment. The headings in Tables VI, VII, and VIII describe the type of operation employed. Vulvectomy was not listed; however, one operation was described as excision of the labia and part of the vagina. In three cases an operation in two stages was done; the

primary lesion was excised and at a later date the inguinal nodes were removed. All other operations in this study were performed in one stage. Surgical diathermy was resorted to in four cases. Of late years this has not been used; however, its merit should be known, since in selected cases it is a rapid method of freeing the field of the primary tumor of necrotic material. These wounds are usually painless, and local healing is rather prompt. Table VI also furnishes data as to the number and percentage of small, medium, and large primary lesions treated by different methods. The table further shows that the majority of the large lesions were treated by radium and roentgen rays or by radium only.

The time of the irradiation was divided into three classifications, as follows: five patients (5.25 per cent) received treatment before operation; post-operative treatment

TABLE VII.—TYPE OF TREATMENT IN RELATION TO GRADE OF PATHOLOGIC LESION

TABLE VII.—TYPE OF TREATMENT IN RELATION TO GROWTH

Microscopic diagnosis	Cases		Excision of growth and								Radium and roentgen rays		Radium		
			Removal of inguinal nodes, radium and roentgen ray		Removal of inguinal nodes and radium		Radium and roentgen rays		Radium						
			Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent					
	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent							
Squamous-cell epithelioma not graded	1	1.49												1	100.00
Squamous-cell epithelioma, graded 1	3	4.47	1	33.33			1	33.33					1	33.33	
Squamous-cell epithelioma, graded 2	28	41.79	4	14.28	3	10.71	3	10.71	12	42.85	2	7.15	4	14.28	
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Basal-cell epithelioma	1	1.49							1	100.00					
Inflammatory tissue	2	2.98									1	50.00	1	50.00	
No biopsy	28	29.47									12	42.85	16	57.14	
Total	95		10	10.52	7	7.36	7	7.36	18	18.94	23	24.21	30	31.57	

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TABLE VIII.—TYPE OF TREATMENT IN RELATION TO YEAR TREATMENT GIVEN

Year	Cases	Excision of growth and					Radium and roentgen rays	Radium
		Removal of inguinal nodes, radium and roentgen ray	Removal of inguinal nodes and radium	Radium and roentgen rays	Radium			
1915	2				1			1
1916	2	1			1			
1917	6	1	3		2			
1918	11	2	1		2	3	3	
1919	13	1	2	1	1	5	3	
1920	8	2		2		3	1	
1921	7	1			1	2	3	
1922	2				1	1		
1923	10		1		1	2	6	
1924	5			3	1		1	
1925	5				3	1	1	
1926	7				1	3	3	
1927	5				2	2	1	
1928	3	1				1	1	
1929	9	1		1	1		6	
Total	95	10	7	7	18	23	30	

Full description of the technic employed in radium therapy will be omitted; however, the type of applicators employed was determined and is recorded in Table IX. The universal silver tube containing 50 mg. radium sulphate (element) was the applicator most frequently used in treating the primary lesion. It was usually screened with 1.0 mm. brass and 2.0 mm. rubber. When distance was interposed balsa wood or dental mold was used. The monel needles contained 10 or 5 mg. radium sulphate (element) and the rays were filtered only through their walls, which were 0.4 mm. thick. Platinum-iridium (walls 0.4 mm.) needles containing 1.0 mg. of radium sulphate (element) were also used with gratifying local results. In only one case in this group were glass seeds or implants employed; this was in 1922.

The universal silver tube was also the applicator of choice in treating the secondary lesions. In cases in which the lesion was ul-

TABLE IX.—METHOD OF APPLICATION OF RADIUM

	Primary lesion		Secondary lesion	
	Cases	Per cent	Cases	Per cent
Tubes	47	55.95	7	14
Needles	10	11.90	1	2
Plaques	9	10.71		
Seeds	1	1.19		
Surface packs	7	8.33	42	84
Tubes and needles	7	8.33		
Tubes and plaques	1	1.19		
Needles, tubes and plaques	1	1.19		
Tubes and surface packs	1	1.19		
Total	84	88.42	50	52.63

cerated, the tubes were usually placed in contact with the surface. In this event I prefer to use tubes containing about 20 millicuries of radon; in this way the time of application is lengthened. The surface pack, previously described (4), was the most popular method in treating the secondary lesions. Effective treatment is difficult and tedious to apply. It is decidedly important to have available a variety of applicators in order to insure employment of the proper technic in a given case. The situation of the lesion and the fact that function of the part is necessary, either during the time of treatment or in the convalescent period after treatment, makes it almost impossible to put the part at rest. Adequate treatment is essential, and yet every endeavor must be made to avoid overtreatment and the resulting radionecrosis and pain. It is also essential to avoid injury of neighboring tissues, such as erythema, in adjacent cutaneous surfaces. These cases tax the ingenuity of the radium therapist in designing, fitting, and maintaining applicators in position for the required time. The initial results are usually gratifying in that the primary lesion heals. However, the metastatic processes are usually only arrested, chiefly because efficient treatment cannot be applied. For treatment of involvement of the inguinal lymph nodes alternative to radium,

TABLE X.—GRADE OF NEOPLASMS IN RELATION TO SURVIVAL OF PATIENTS

TABLE X.—GRADE OF EPITHELIOMA

Range of years following treatment	Cases with definite information														Patients living at the end of the period specified in the first column			
	Cases	No biopsy	Inflammatory	Epithelioma								Died		Lost track of		Patients whose experience does not continue into following year		Patients whose experience continues into following year
				Not graded	Grade 1	Grade 2	Grade 3	Grade 4	Basal-cell epithelioma	Adenocarcinoma graded 2	Patients	Per cent of total deaths	Patients	Per cent of total lost track of	Cases	Per cent of total living	Cases	
0 to 1	79	18	1	1	3	25	18	10	1	2	26	49	4	36			49	
1 to 2	49	7	1		3	17	11	7	1	2	16	30	1	9	3	20	29	
2 to 3	29	2	1		3	13	4	4	1	1	6	11	3	27			20	
3 to 4	20	1			3	8	4	2	1	1	1	2			1	6.66	18	
4 to 5	18	1			3	8	3	1	1	1	2	4			2	13.33	14	
5 to 6	14	1			2	5	3	1	1	1	2	4					12	
6 to 7	12	1			1	5	3	1		1			1	9	1	6.66	10	
7 to 8	10	1			1	4	3	1							2	13.33	8	
8 to 9	8	1			1	4	2										8	
9 to 10	8	1			1	4	2						2	18	2	13.33	4	
10 to 11	4				1	3									1	6.66	3	
11 to 12	3				1	2									1	6.66	2	
12 to 13	2					2											2	
13 to 14	2					2									1	6.66	1	
14 to 15	1					1											1	
15 to 16	1					1									1	6.66		
Total	79*										53		11		15			
Per cent of total dead and living (68)											77.94		13.92**		22.05			

*Total number of cases at start of study.

**Percentage of total number of cases (79).

moderate voltage roentgen therapy (18) may be given over the inguinal regions employing multiple fields, and so-called high voltage roentgen therapy may be given over a large posterior field. However, for treatment of secondary involvement of the pelvis, high voltage roentgen therapy is the method of choice, and may be given through anterior and posterior portals.

The grade of neoplasm in relation to survival of patients, as well as the late results in all cases concerning which definite information is available, is given in Table X. The table shows that the ultimate prognosis in cases in which lesions are of Grade 3 or 4 is more grave than in those in which

lesions are of Grade 1 or 2. More proof will be offered when Table XI is considered.

Concerning 79 of the 95 cases in the series definite or complete information was available. The growths in 60 of these 79 cases were proved microscopically to be malignant, and in 19 cases they appeared on macroscopic examination to be malignant. In the first year 26 patients died (49 per cent of the total number of those who died) and four patients (36 per cent of the total) were not traced. Therefore, at the end of the first period specified in the left-hand column of Table X, 49 patients were remaining whose experience continues into the second range of years. This will illustrate the

TABLE VIII.—TYPE OF TREATMENT IN RELATION TO YEAR TREATMENT GIVEN

Year	Cases	Excision of growth and				Radium and roentgen rays	Radium
		Removal of inguinal nodes, radium and roentgen ray	Removal of inguinal nodes and radium	Radium and roentgen rays	Radium		
1915	2				1		1
1916	2	1			1		
1917	6	1	3		2		
1918	11	2	1		2	3	3
1919	13	1	2	1	1	5	3
1920	8	2		2		3	1
1921	7	1			1	2	3
1922	2				1	1	
1923	10		1		1	2	6
1924	5			3	1		1
1925	5				3	1	1
1926	7				1	3	3
1927	5				2	2	1
1928	3	1				1	1
1929	9	1		1	1		6
Total	95	10	7	7	18	23	30

Full description of the technic employed in radium therapy will be omitted; however, the type of applicators employed was determined and is recorded in Table IX. The universal silver tube containing 50 mg. radium sulphate (element) was the applicator most frequently used in treating the primary lesion. It was usually screened with 1.0 mm. brass and 2.0 mm. rubber. When distance was interposed balsa wood or dental mold was used. The monel needles contained 10 or 5 mg. radium sulphate (element) and the rays were filtered only through their walls, which were 0.4 mm. thick. Platinum-iridium (walls 0.4 mm.) needles containing 1.0 mg. of radium sulphate (element) were also used with gratifying local results. In only one case in this group were glass seeds or implants employed; this was in 1922.

The universal silver tube was also the applicator of choice in treating the secondary lesions. In cases in which the lesion was ul-

TABLE IX.—METHOD OF APPLICATION OF RADIUM

	Primary lesion		Secondary lesion	
	Cases	Per cent	Cases	Per cent
Tubes	47	55.95	7	14
Needles	10	11.90	1	2
Plaques	9	10.71		
Seeds	1	1.19		
Surface packs	7	8.33	42	84
Tubes and needles	7	8.33		
Tubes and plaques	1	1.19		
Needles, tubes and plaques	1	1.19		
Tubes and surface packs	1	1.19		
Total	84	88.42	50	52.63

cerated, the tubes were usually placed in contact with the surface. In this event I prefer to use tubes containing about 20 millicuries of radon; in this way the time of application is lengthened. The surface pack, previously described (4), was the most popular method in treating the secondary lesions. Effective treatment is difficult and tedious to apply. It is decidedly important to have available a variety of applicators in order to insure employment of the proper technic in a given case. The situation of the lesion and the fact that function of the part is necessary, either during the time of treatment or in the convalescent period after treatment, makes it almost impossible to put the part at rest. Adequate treatment is essential, and yet every endeavor must be made to avoid overtreatment and the resulting radionecrosis and pain. It is also essential to avoid injury of neighboring tissues, such as erythema, in adjacent cutaneous surfaces. These cases tax the ingenuity of the radium therapist in designing, fitting, and maintaining applicators in position for the required time. The initial results are usually gratifying in that the primary lesion heals. However, the metastatic processes are usually only arrested, chiefly because efficient treatment cannot be applied. For treatment of involvement of the inguinal lymph nodes alternative to radium,

TABLE X.—GRADE OF NEOPLASMS IN RELATION TO SURVIVAL OF PATIENTS

TABLE X. GRADE OF RESECTION

Range of years following treatment	Cases with definite information														Patients living at the end of the period specified in the first column			
	Cases	No biopsy	Inflammatory	Epithelioma						Basal-cell epithelioma	Adenocarcinoma graded 2	Died		Lost track of		Patients whose experience does not continue into following year		Patients whose experience continues into following year
				Not graded	Grade 1	Grade 2	Grade 3	Grade 4	Patients			Per cent of total deaths	Patients	Per cent of total lost track of	Cases	Per cent of total living		
0 to 1	79	18	1	1	3	25	18	10	1	2	26	49	4	36			49	
1 to 2	49	7	1		3	17	11	7	1	2	16	30	1	9	3	20	29	
2 to 3	29	2	1		3	13	4	4	1	1	6	11	3	27			20	
3 to 4	20	1			3	8	4	2	1	1	1	2			1	6.66	18	
4 to 5	18	1			3	8	3	1	1	1	2	4			2	13.33	14	
5 to 6	14	1			2	5	3	1	1	1	2	4					12	
6 to 7	12	1			1	5	3	1		1			1	9	1	6.66	10	
7 to 8	10	1			1	4	3	1							2	13.33	8	
8 to 9	8	1			1	4	2							--			8	
9 to 10	8	1			1	4	2						2	18	2	13.33	4	
10 to 11	4				1	3									1	6.66	3	
11 to 12	3				1	2									1	6.66	2	
12 to 13	2					2											2	
13 to 14	2					2									1	6.66	1	
14 to 15	1					1											1	
15 to 16	1					1									1	6.66		
Total	79*										53		11		15			
Per cent of total dead and living (68)											77.94		13.92**		22.05			

*Total number of cases at start of study.

**Percentage of total number of cases (79).

moderate voltage roentgen therapy (18) may be given over the inguinal regions employing multiple fields, and so-called high voltage roentgen therapy may be given over a large posterior field. However, for treatment of secondary involvement of the pelvis, high voltage roentgen therapy is the method of choice, and may be given through anterior and posterior portals.

The grade of neoplasm in relation to survival of patients, as well as the late results in all cases concerning which definite information is available, is given in Table X. The table shows that the ultimate prognosis in cases in which lesions are of Grade 3 or 4 is more grave than in those in which

lesions are of Grade 1 or 2. More proof will be offered when Table XI is considered.

Concerning 79 of the 95 cases in the series definite or complete information was available. The growths in 60 of these 79 cases were proved microscopically to be malignant, and in 19 cases they appeared on macroscopic examination to be malignant. In the first year 26 patients died (49 per cent of the total number of those who died) and four patients (36 per cent of the total) were not traced. Therefore, at the end of the first period specified in the left-hand column of Table X, 49 patients were remaining whose experience continues into the second range of years. This will illustrate the

TABLE XI.—GRADE OF EPITHELIOMA IN RELATION TO NUMBER OF PATIENTS WHO HAVE LIVED VARIOUS NUMBERS OF YEARS

Range of years following treatment	Epithelioma Grades 1 and 2						Epithelioma Grades 3 and 4					
	(A) Total cases	(B) Died	Lost track of	Patients living at the end of the period specified in the first column			(A) Total cases	(B) Died	Lost track of	Patients living at the end of the period specified in the first column		
				Patients whose experience does not continue into following year	Patients whose experience continues into following year					Patients whose experience does not continue into following year	Patients whose experience continues into following year	
0 to 1	28	7	1	0	20		28	10	0	0	18	
1 to 2	20	3	1	0	16		18	7	0	2	8	
2 to 3	16	4	1	0	11		8	2	0	0	6	
3 to 4	11	0	0	0	11		6	1	0	1	4	
4 to 5	11	2	0	2	7		4	0	0	0	4	
5 to 6	7	1	0	0	6		4	0	0	0	4	
6 to 7	6	0	1	0	5		4	0	0	0	4	
7 to 8	5	0	0	0	5		4	0	0	2	2	
8 to 9	5	0	0	0	5		2	0	0	0	2	
9 to 10	5	0	1	0	4		2	0	1	1	0	
10 to 11	4	0	0	1	3							
11 to 12	3	0	0	1	2							
12 to 13	2	0	0	0	2							
13 to 14	2	0	0	1	1							
14 to 15	1	0	0	0	1							
15 to 16	1	0	0	1	0							
Death rate per year 13.32 ± 2.03 per cent*						Death rate per year 26.25 ± 3.32 per cent						
Difference between death rates $= 12.93 \pm 3.89$ per cent												

*Death rate per cent = $\frac{\text{total (of Column B)}}{\text{total (of Column A)}} \times 100 = \frac{\text{total deaths}}{\text{total number of experience years}} \times 100$

way to interpret Table X. The cases in which the growths were assumed by macroscopic examination to be malignant can be determined in each horizontal line by adding the quantity in the column headed "no biopsy" and the quantity in the column headed "inflammatory." The horizontal sum of the quantities in the next seven columns to the right will give the number of cases in which the malignancy was determined by microscopic examination. The assumption that the clinical diagnosis of carcinoma of the vulva in this group was correct seems justified, since only seven of the 18 patients in whose cases clinical evidence was relied on

for diagnosis, entered the second period of experience, and only two entered the third period. Often, owing to extensive involvement, associated secondary infection, and concomitant general poor health of the patient, material for biopsy is not obtained.

As a final analysis of the 79 cases observed during this period of sixteen years, 53 patients (77.94 per cent) of the 68 who could be treated are dead, and 15 (22.05 per cent) are known to be living. I have lost track of eleven patients (13.92 per cent) of the total number of cases at the start of the study. It is generally accepted that Broders' method of grading epitheliomatous neo-

plasms in a great measure furnishes ground for prognosis, and especially in groups of surgical cases.

Table XI shows the grade of epithelioma in relation to length of life in this group of 56 patients. The headings are similar to those in Table X and the analysis remains the same. It is evident that patients with lesions graded 1 and 2 live a greater number of years after treatment than those who have lesions graded 3 and 4. The calculated death rate² per year for patients with lesions graded 1 and 2 is 13.32 ± 2.03 per cent, whereas the death rate per year for patients with lesions graded 3 and 4 is 26.25 ± 3.32 per cent. Since these death rates have been established on only 127 and 180 years of experience, respectively, one wonders if the difference of 13 per cent between them is due to the higher grades of malignancy in one group or whether it is a difference that could arise by sampling. The difference is 12.93 ± 3.89 , or 3.3 times its probable error, which is equivalent to saying that the chances in favor of this being a difference due to something other than sampling are ninety-eight in a hundred. It is evident that the death rate per year for patients with lesions of high grade is double that of patients with lesions of low grade. The fact that the death rate is higher in cases of epithelioma in which the growth is graded 3 or 4 than in cases in which it is graded 1 or 2 furnishes new evidence that Broders' method of grading neoplasms is of value in prognosis.

Table XII records the death rate in percentage for patients with different grades of epithelioma. The table furnishes definite evidence that the grade of malignancy in-

TABLE XII.—DEATH RATES FOR GRADES OF EPITHELIOMA IN RELATION TO YEARS OF LIFE AFTER TREATMENT (LIFE YEARS OF EXPERIENCE)

Range of years following treatment	All cases with definite information			Epithelioma graded 1 and 2			Epithelioma graded 3 and 4		
	Life years of experience	Died	Death rate, per cent	Life years of experience	Died	Death rate, per cent	Life years of experience	Died	Death rate, per cent
0 to 1	79	26	32.9	28	7	25.0	28	10	35.7
0 to 2	128	42	32.8	48	10	20.8	46	18	39.1
0 to 3	157	48	30.6	64	14	21.9	54	20	37.0
0 to 4	177	49	27.7	75	14	18.7	60	21	35.0
0 to 5	195	51	26.1	86	16	18.6	64	21	32.8
0 to 6	209	53	25.3	93	17	18.3	68	21	30.9
0 to 7	221	53	24.0	99	17	17.2	72	21	29.2
0 to 8	231	53	22.9	104	17	16.3	76	21	27.6
0 to 9	239	53	22.2	109	17	15.6	78	21	26.9
0 to 10	247	53	21.4	114	17	14.9	80	21	26.2
0 to 11	251	53	21.1	118	17	14.4			
0 to 12	254	53	20.9	121	17	14.0			
0 to 13	256	53	20.7	123	17	13.8			
0 to 14	258	53	20.5	125	17	13.6			
0 to 15	259	53	20.5	126	17	13.5			
0 to 16	260	53	20.4	127	17	13.4			

fluences the percentage death rate in the respective groups; lesions graded 3 and 4 give the greatest percentage death rate. In the first column of the table is recorded the range or extent of years following treatment; in the second column all cases are grouped together. For the first year, seventy-nine life years of experience was accumulated by the group and 26 patients died, giving a death rate of 32.91 per cent. At the end of the fifth year, one hundred and ninety-five life years of experience had been accumulated by the group and 51 patients had died, giving a death rate of 26.15 per cent, and so on. In a similar way the lesions graded 1 and 2 and those graded 3 and 4 were considered and recorded. This table gives further evidence that the grade of malignancy encountered furnishes definite information concerning prognosis. These facts also enter into consideration of the best type of treatment to employ in a given case; that is, operation

²To-day certain words and phrases used in life insurance tables have found place in medical literature; for example, the word "risk" and the expression "life expectancy" have definite medical definitions. The term "life experience" as used in life insurance tables may be borrowed and as time passes may prove of value in estimating results obtained from treatment in terms of the death rate in certain diseases or in groups occurring in them. In this study, "life experience" is used to signify the total number of years of life of all individuals in a group taken together; "death rate per cent" signifies the total number of deaths per 100 experience years (this concept is applied in Tables XI and XII).

only, radium only, roentgen rays only, or any combination of operation, radium, and roentgen rays.

CONCLUSIONS

The best results are possible only when all factors are considered. The wide range of treatment furnishes a decidedly flexible and thoroughly individual method to meet the requirements of the patient. All concerned must co-operate to the utmost for the best interests of the patient.

Precancerous lesions under consideration should be adequately dealt with; proper means should be instituted for their control, and, in this way, as far as possible, the chance of malignant degeneration or change occurring should be prevented.

In the group in which palliation only can be expected, every endeavor should be made to avoid the production of radionecrosis. Instead, the selective absorption of the therapeutic rays should be employed. It is astonishing to observe the degree of palliation or the restoration of satisfactory function of the diseased part possible in certain cases.

The greatest chance of cure is in the case in which there is a small or early lesion of rather low grade of malignancy that has been adequately dealt with. Adequate treatment is possible only through co-operation of all concerned, and full realization of the value of surgery, radium, and roentgen rays.

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DR. BOWING (closing): In the paper I have stressed the importance of recognizing and treating as early as possible the so-called pre-cancerous lesions occurring in the vulva, such

as pruritus vulvæ and leukoplakic vulvitis. In selected cases section of the internal pudic nerve or vulvectomy should be considered as a prophylactic or curative procedure.

Telestereoroentgenography. Louis Diocles. *Am. Jour. Surg.*, December, 1930, X, 499.

The author first describes the history of stereoroentgenography and then describes the theory and technic of producing stereoroentgenograms. Realizing that the stereoscopic image of a thick portion of the body, such as the thorax, made at a focal distance of less than a meter gives a defective plastic result, he feels that the use of teleroentgenography gives more definite and undisputed images whose superimposition is effected more easily. By the use of more powerful X-ray apparatus, good films can be made at these relatively great distances, using a short exposure.

In using this greater distance, unless the tube-shift distance is worked out carefully, the stereoscopic effect will be poor and the films appear flat. The author has therefore worked out by formula the amount of the tube shift for various focal distances. The time for the two exposures must be very short, as other-

wise any movement of the viscera may spoil the stereoscopic effect. He then describes the telestereoroentgenographic apparatus which he has had constructed and which is entirely automatic, and allows the making of a stereogram in a fraction of a second. He then describes several similar pieces of apparatus which are made by firms on the Continent.

The examination of the films can be carried out with the aid of two types of stereoscopes: First, mirror stereoscopes; and second, prism stereoscopes. He also describes the various commercial machines embodying these principles, and makes reductions from the films and examines these by the aid of a hand stereoscope. He states, however, that the best stereoscope and the simplest is our own visual apparatus. A slight muscular effort analogous to a trial strabismus allows the convergence of the optical axes and the perception of the relief. It is also possible to project these stereoroentgenograms by the use of a special lantern.

HOWARD P. DOUB, M.D.

THE TREATMENT OF COMPRESSED AND IMPACTED FRACTURES OF THE BODIES OF THE VERTEBRÆ¹

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THE treatment of compression fractures of the bodies of the vertebræ has received a great deal of attention in recent years, since correct X-ray exposures have demonstrated the frequency of this injury.

Decompression has been accomplished in several ways by different men. The method of decompression and reduction to be described was originated in 1927, and has been very successful and has proven to be safe. This paper deals only with those cases which do not have symptoms of injury to the spinal cord and those cases in which the demonstrable injury is limited to the body of a vertebra.

The treatment is carried out in the manner to be described. The patient is given a general anesthetic to insure complete muscular relaxation during the process of decompression and reduction. Strong traction and counter-traction are obtained by having two men pull downward on the ankles while two others pull strongly upward on sheets crossed beneath the shoulders and over the chest. A sheet is folded to a width of eight inches and is passed beneath the injured segments as the patient lies on his back.

Then by means of this sheet the operator and his assistant toss the patient straight upward and catch his weight while he is still in hyperextension; the strong traction is maintained throughout this maneuver. The force of the manipulation can be graduated to the individual case. Where impaction is present considerable force may be necessary to disengage the fragments. On the other hand, in cases in which there has been comminution of the bone a gentle lifting motion will be found sufficient to restore the

various portions of the bone to their normal relations.

After the decompression has been done the reduction is maintained by placing the patient in marked hyperextension on a Goldthwait frame while he is still completely relaxed. The proper placing of the patient on a correctly curved bar is an essential step in this procedure. A cast is then applied in order to hold the corrected position. Experience indicates that the patient should not be placed in a face-down position while in the cast, as this has resulted in some reduction in the vertical height of a vertebral body which had previously been pulled out to a normal height. The time in the cast has usually been four months. In cases in which much bone destruction has occurred the time has been increased until the X-ray demonstrated the rebuilding of the bone structure.

During previous discussions of this subject the question has often been asked, "Is such radical and long-continued treatment necessary in these simple compression fractures?" The answer is, "Yes." The failure of immobilization and the failure even of stabilization operations to give satisfactory results, especially in industrial cases, is attested by Eikenbary, of Seattle, who reviewed two hundred cases in 1928. He stated as a result of this study:

In the list of state industrial patients whom I have examined or treated, together with the seventy-five patients whose records I have examined, only a few—not more than five—were returned to hard labor without a considerable percentage of disability, the figures ranging all the way from 10 per cent up.

These poor functional results are easily understood, because there is permanent deformity of the body of the vertebra and a

¹Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1-5, 1930.

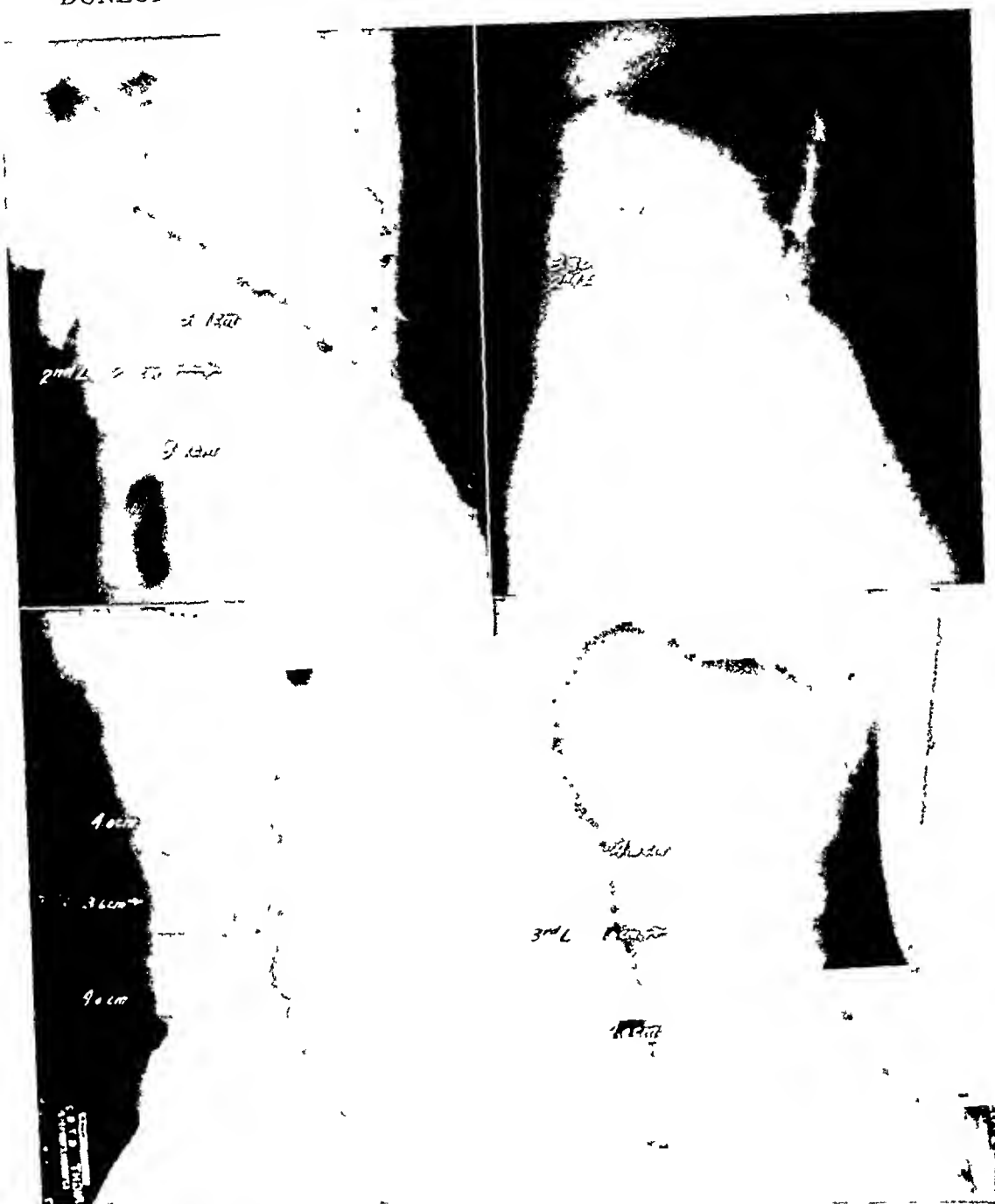


Fig 1 (upper left) Case 1 Before reduction (October 10, 1927) Fracture of the second lumbar vertebra The compression amounted to at least 1 centimeter (Previously published in the *Journal of the American Medical Association*, 1930 Republished because this was the first fracture reduced by Dr Dunlop)

Fig 2 (upper right) Case 1 This shows the appearance of the fractured vertebra 1 year 4 months after the reduction (Previously published in the *Journal of the American Medical Association*, 1930)

Fig 3 (lower left) Case 2 Before reduction Impacted fracture of the third lumbar vertebra in a heavy man (Previously published in the *Journal of the American Medical Association*, 1930)

Fig 4 (lower right) Case 2 Six months after reduction (Previously published in the *Journal of the American Medical Association*, 1930) Republished because this man, a motorcycle officer, has returned to full duty and two recent serious falls have caused no recurrence of the deformity in the healed vertebra



Fig. 5 (upper left). Case 3. A badly comminuted fracture of the second lumbar vertebra before reduction. The fragments are widely separated but are in nearly correct position.

Fig. 6 (upper right). Case 3. Patient in cast four days after reduction.

Fig. 7 (lower left). Case 3. Eight months after reduction, with the patient up and taking long. Note the very satisfactory healing of the bone and the height of the vertebral body.

Fig. 8 (lower right). Case 4. Compression fracture of the eleventh dorsal before reduction.



Fig. 9 (upper left). Case 4. Four days after reduction. The compression was completely overcome.

Fig. 10 (upper right). Case 4. One year after reduction. The injured vertebra lost height while the patient was in her cast, probably because she was frequently turned face down in the cast. After the bone healed there was no further loss in height. There is also narrowing of the intervertebral space above.

Fig. 11 (lower left). Case 5. Compression fractures of the sixth and seventh dorsal vertebrae before reduction.

Fig. 12 (lower right). Case 5. Four days after reduction. This patient illustrates the difficulty of obtaining complete reductions above the level of the ninth dorsal.

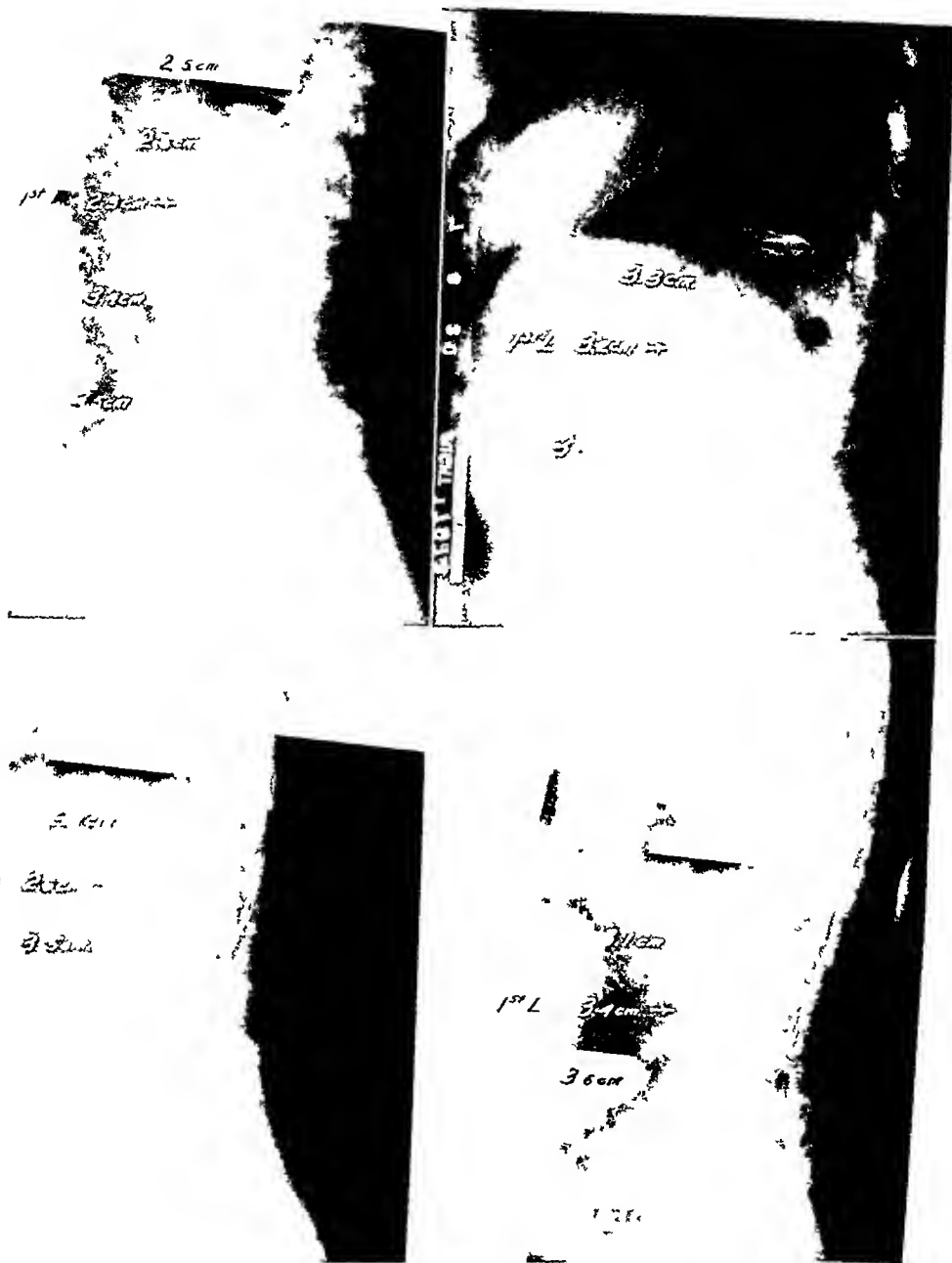


Fig 13 (upper left) Case 6 Compressed fracture of the first lumbar before reduction (Patient of Dr Frank Hodgdon, of Pasadena)

Fig 14 (upper right) Case 6 Nine months after reduction (Patient treated by Dr Frank Hodgdon, of Pasadena)

Fig 15 (lower left) Case 7 Compression fracture of the first lumbar vertebra before reduction (Patient of Dr Robert K Gustafson, of Pasadena)

Fig 16 (lower right) Case 7 Five days after reduction (Patient treated by Dr Robert K Gustafson, of Pasadena)

mal-alignment which causes even the undamaged articular facets to move abnormally in relation to each other. In many of the uncorrected cases there is an angle in the spine, with the apex of the angle opposite

restore him to normal health or to compensate him for permanent disability. The demonstration in court of roentgenograms showing the reduction and restoration of the fractured vertebræ should result in a fair

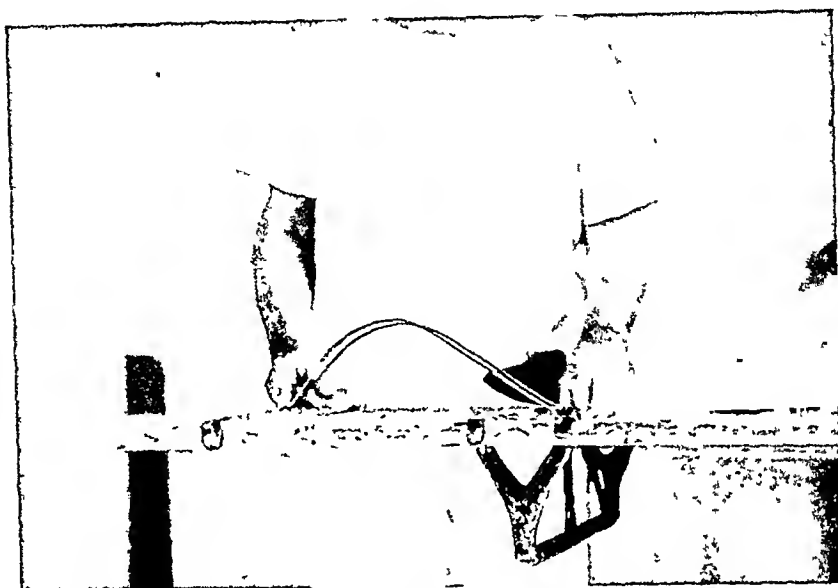


Fig. 17. The Goldthwait bars, which can be bent to any desired height, to insure the proper degree of hyperextension in the cast.

the injured segment. A final evaluation of the new method must depend on experience with many cases over a long period of time. Suffice it to say that the results thus far have been excellent, with several patients back at heavy work without any disability. The most striking instance is that of a police motorcycle officer who showed a perfect anatomical and functional result and returned to his regular duties after seven months. He has since suffered two severe falls from his machine in the course of duty without evidence of any further injury to his repaired second lumbar vertebra.

The psychological effect of complete reduction and healing of the bone is of major importance in industrial and medico-legal cases. The person injured in an industrial or railroad accident expects the company to

award instead of the excessive damages so often given in the past. The intelligent employee or private patient with a broken back will be made to feel that he has been given correct and effective treatment for his condition, and will have greater confidence in returning to his ordinary duties.

Two other points deserve consideration: First, will the surgeon succeed in accomplishing a reduction, and second, is it a safe procedure?

In our hands practically all of the thirty cases have shown a satisfactory reduction; naturally, some reductions have been more nearly perfect than others. The less perfect reductions were obtained in injuries above the ninth dorsal and in one case in which the treatment was delayed twelve days because of a threatened pneumonia. Excel-

lent reductions have also been obtained in Pasadena and Los Angeles by other surgeons. Anatomically, the success of the manipulation depends on intact articular facets, the strong anterior longitudinal ligament, and the firm attachment of the vertebral discs to the bodies of the vertebræ.

None of our patients have developed any evidence of cord injury. The safety of the procedure depends on intact articular facets, on the strong traction which tends to restore normal alignment, and finally, on the fact that all the applied force is in the direction

of hyperextension; the patient is never in flexion during the procedure of reduction.

SUMMARY

Our experience with this method of treating compression fractures of the bodies of the vertebræ leads to the conclusion that this method will succeed in the great majority of cases and that it is quite safe when good judgment and common sense are employed. The steps in the procedure have been carefully outlined—we consider each detail essential.

NEW YORK CITY AND THE CANCER PROBLEM¹

WHAT THE MUNICIPALITY IS DOING IN THE CARE AND TREATMENT OF CANCER PATIENTS, IN PROPAGANDA FOR PREVENTION OF CANCER, AND IN RESEARCH WORK FOR CANCER THERAPY

By IRA I. KAPLAN, B.S., M.D.,

Director, Division of Cancer, Department of Hospitals; Radiation Therapist, Bellevue Hospital; Associate Radium Therapist, Lenox Hill Hospital; Consultant Radiation Therapist, Unity Hospital, Brooklyn; Clinical Professor of Surgery, New York University and Bellevue Medical College, New York City

From the Division of Cancer, Department of Hospitals, New York City, Dr. J. G. William Greeff, Commissioner

THE problems which confront the welfare agencies of the City of New York in caring for its sick are indeed tremendous and not the least difficult of these is the care of sufferers from cancer. The

secondary aim is its effort to conduct a widespread campaign among the profession and the laity for cancer prevention. To attain these objectives a Division of Cancer has been created, which concerns itself with the

CANCER DEATHS ARE INCREASING NEW YORK CITY

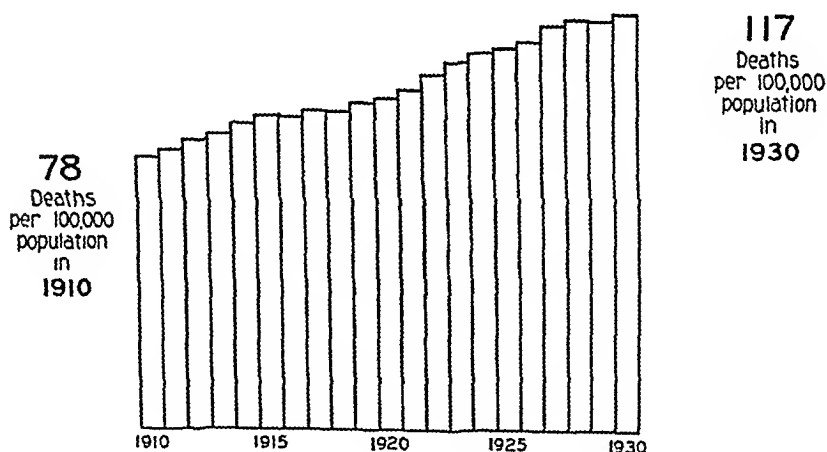


Fig. 1.

primary aim of the Department of Hospitals in this connection is, naturally, the amelioration of the conditions presented, with the hope of obtaining a cure in each case. A

diagnosis, care, and treatment of cancer patients in the hospitals and clinics of the Department; with informing the public, in co-operation with other health agencies, regarding cancer and its prevention; with educating the profession in the diagnosis and treat-

¹Read before the Third International Congress on Radiology, Paris, July, 1931.

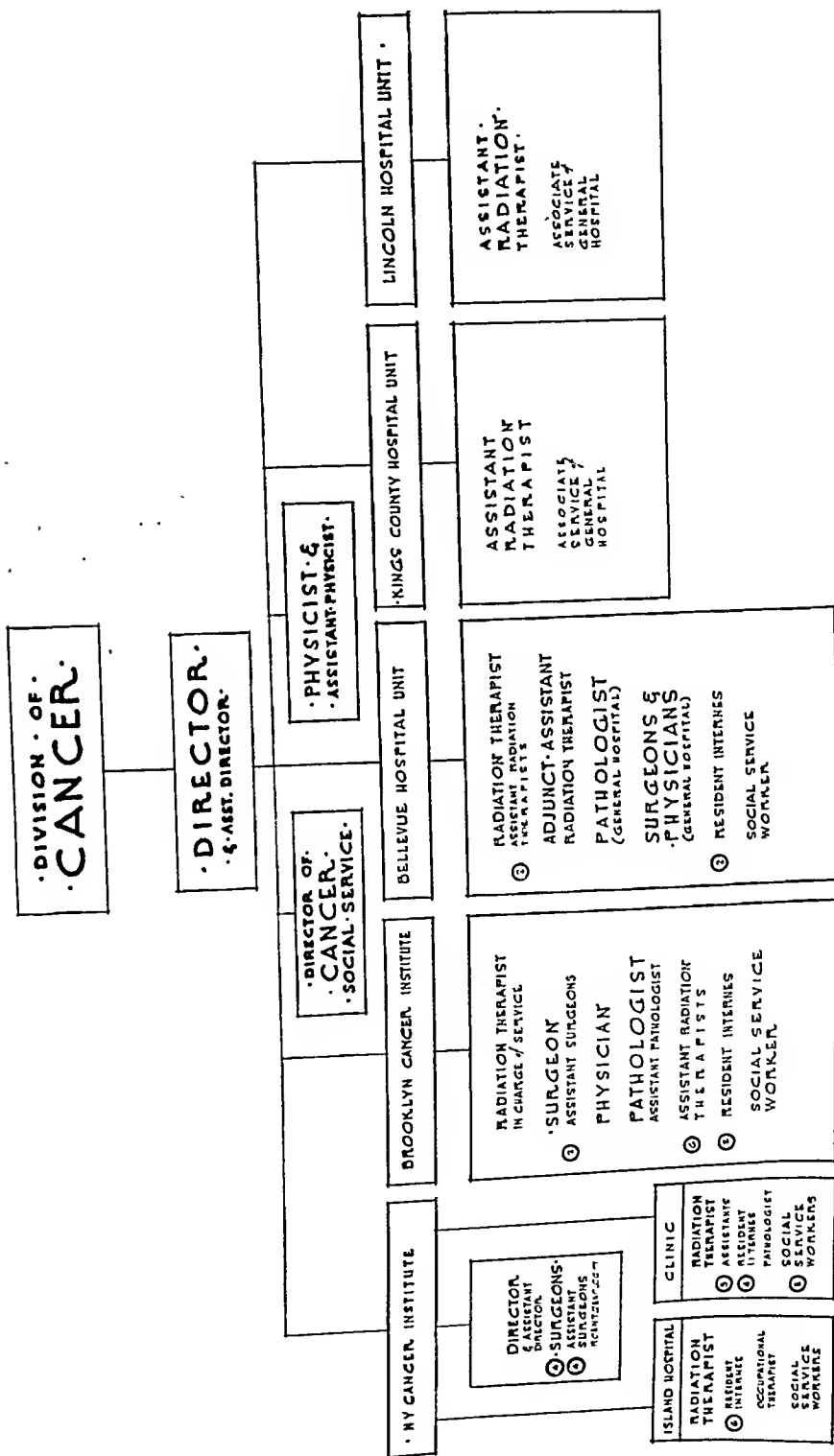


Fig. 2.

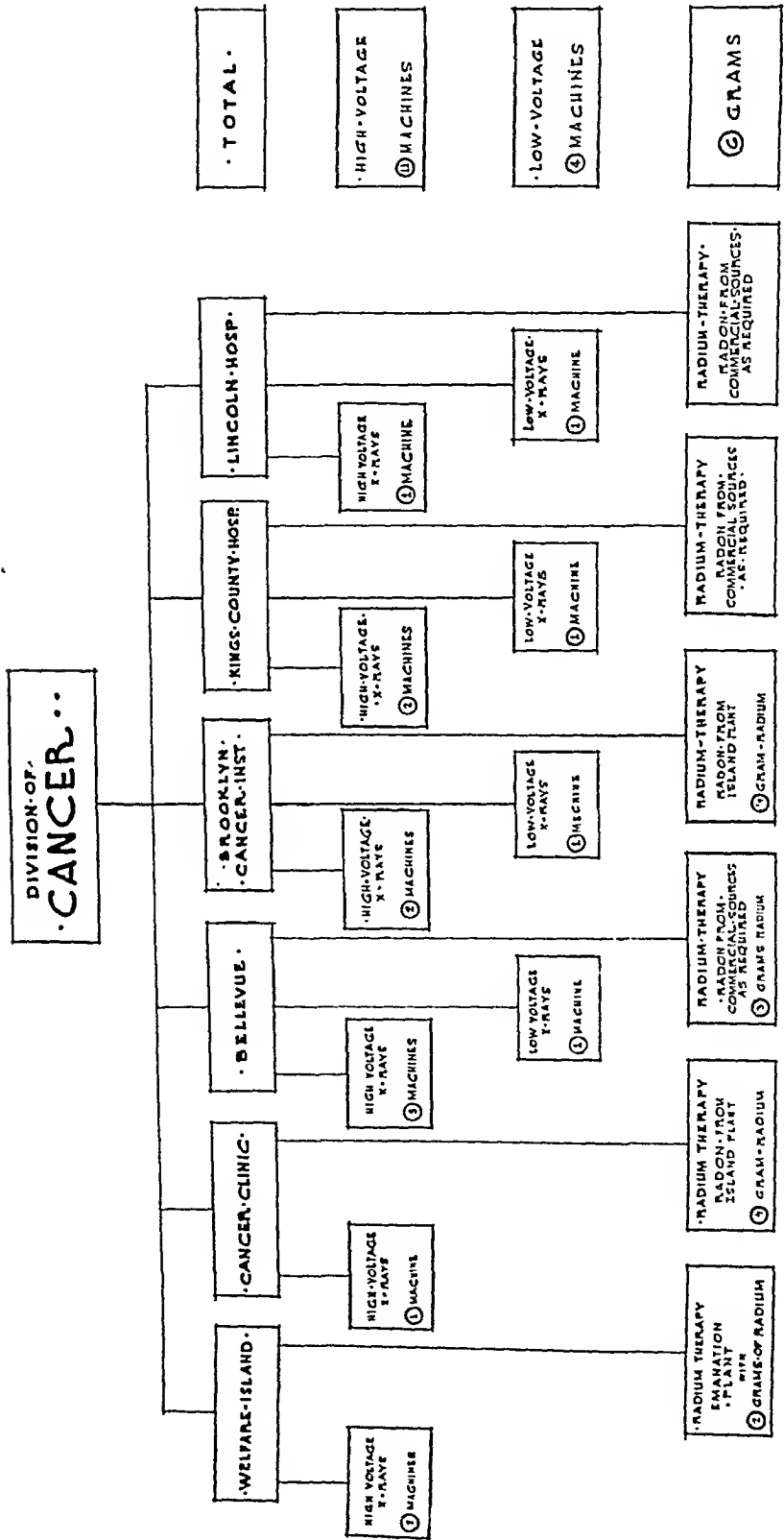


Fig. 3.

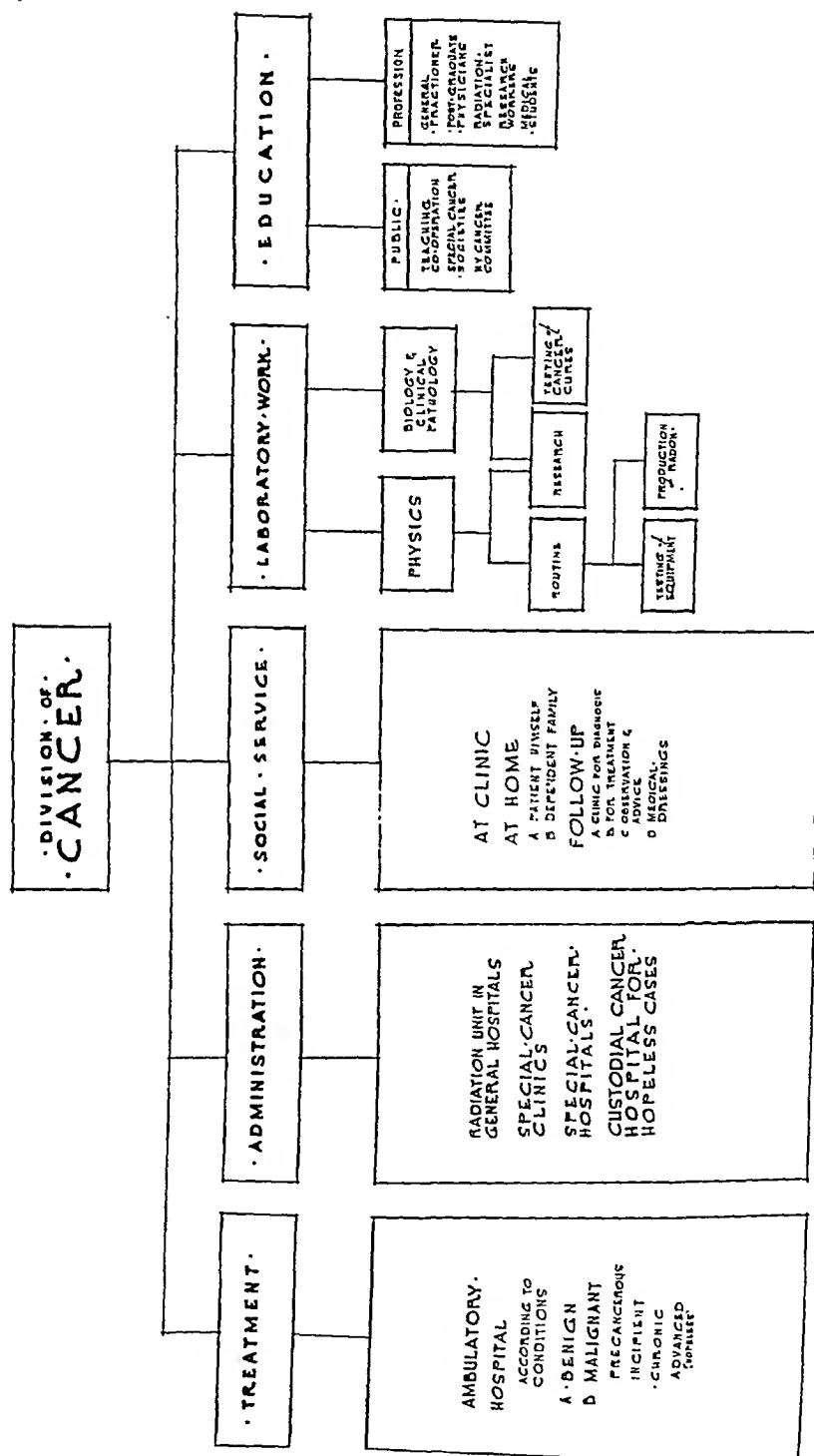


Fig. 4.

ment of cancer, and with conducting research work in the origin, cause, treatment, and prevention of cancer.

During the year 1930 there came under the jurisdiction of the Division approximately 7,000 cases, benign and malignant. To provide for future requirements, the City of New York has planned and already started to build a new special hospital of 400 beds to care for cancer patients. This will be the largest hospital of the kind in the United States, if not in the world, devoted exclusively to the diagnosis of cancer, the care and treatment of cancer patients, research work in the cause and cure of cancer, and the instruction of the lay public as well as of students and practitioners of medicine.

The hospitals constituting the municipal system are open to all citizens, irrespective of race, color, or creed, and the treatment is given free of cost to all patients admitted. All kinds of patients are received, suffering from all types of diseases, and in various stages and conditions. Cancer patients may come to any hospital in the system, but as the modern practice is to segregate patients afflicted with special diseases, such as tuberculosis, specific infection, etc., cancer cases are referred as far as possible to those units in the general hospital system where specialized care and treatment can be given them by a specialized organization.

Cancer patients may be grouped as incipient, chronic, and hopeless.

Incipient Cases.—Positive cure is contingent on two factors—early diagnosis and prompt, appropriate treatment, whether this be surgery, radiation therapy, or both. Therefore a grave responsibility rests upon the surgeon and the therapist in that each must employ the correct procedure at the outset, for if the surgical excision is incompletely done or the radiation improperly administered, the left-over malignant growth may develop all the more vigorously, and,

as is known, secondary attempts at cure are less likely to prove successful.

Chronic Cases.—With our present knowledge, we can expect in chronic cases little more than palliative results, although spectacular cures may sometimes occur. While it is possible, however, to prolong the life of the patient, to do so is not always easy nor at times even advisable, for the prolonged existence may prove to be one of exquisite pain. Thus, irradiation of an incurable tumor, while prolonging the patient's life, has not infrequently been followed by necrosis, producing a painful condition which, to the patient, may be worse than death itself. Chronic cases must remain under constant supervision, therefore, with the treatments being administered only by those already familiar with the conditions and the methods used for their care.

Hopeless Cases.—These are adequately cared for in a custodial hospital where their gradual transition from life is rendered as painless and as comfortable as possible. The ever-increasing progress being made in the care and treatment of incipient and chronic cases makes it not unreasonable to expect that the number of hopeless cancer cases will steadily diminish.

For the purpose of carrying out this work the Division of Cancer has established separate cancer hospitals as well as special radiation units in several of the large general hospitals in the City's (hospital) system.

The headquarters of the Division of Cancer is the Radiation Unit at Bellevue Hospital, the largest municipal institution for the care of the sick, and the model after which the others are patterned. It is closely associated with the surgical, medical, and pathological staffs of the hospital itself and of the New York University and Bellevue Medical College. Besides possessing a special ward for radium therapy, it has at its disposal as many beds in the general wards of the hospital as may be needed for the

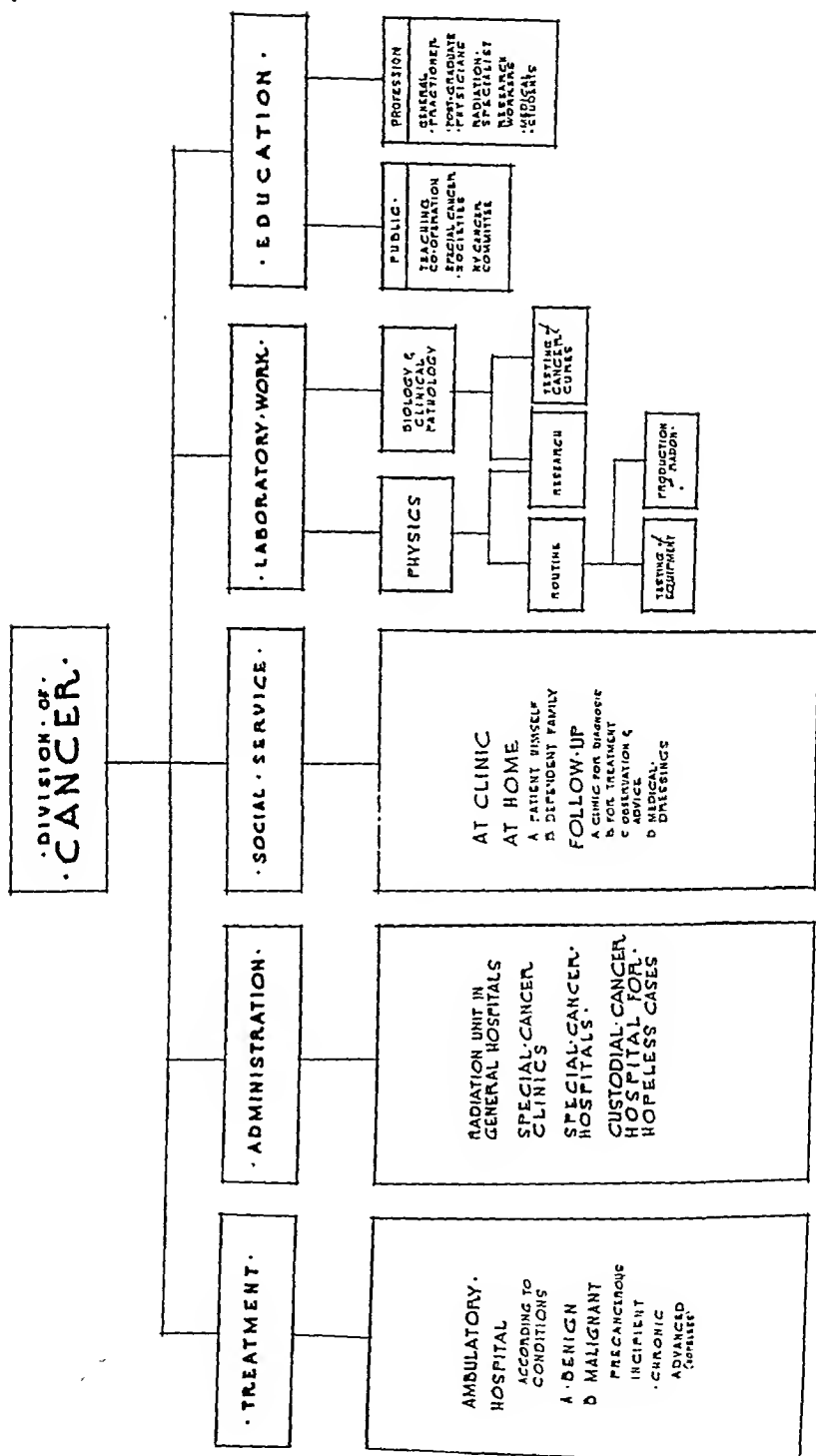


Fig. 4.

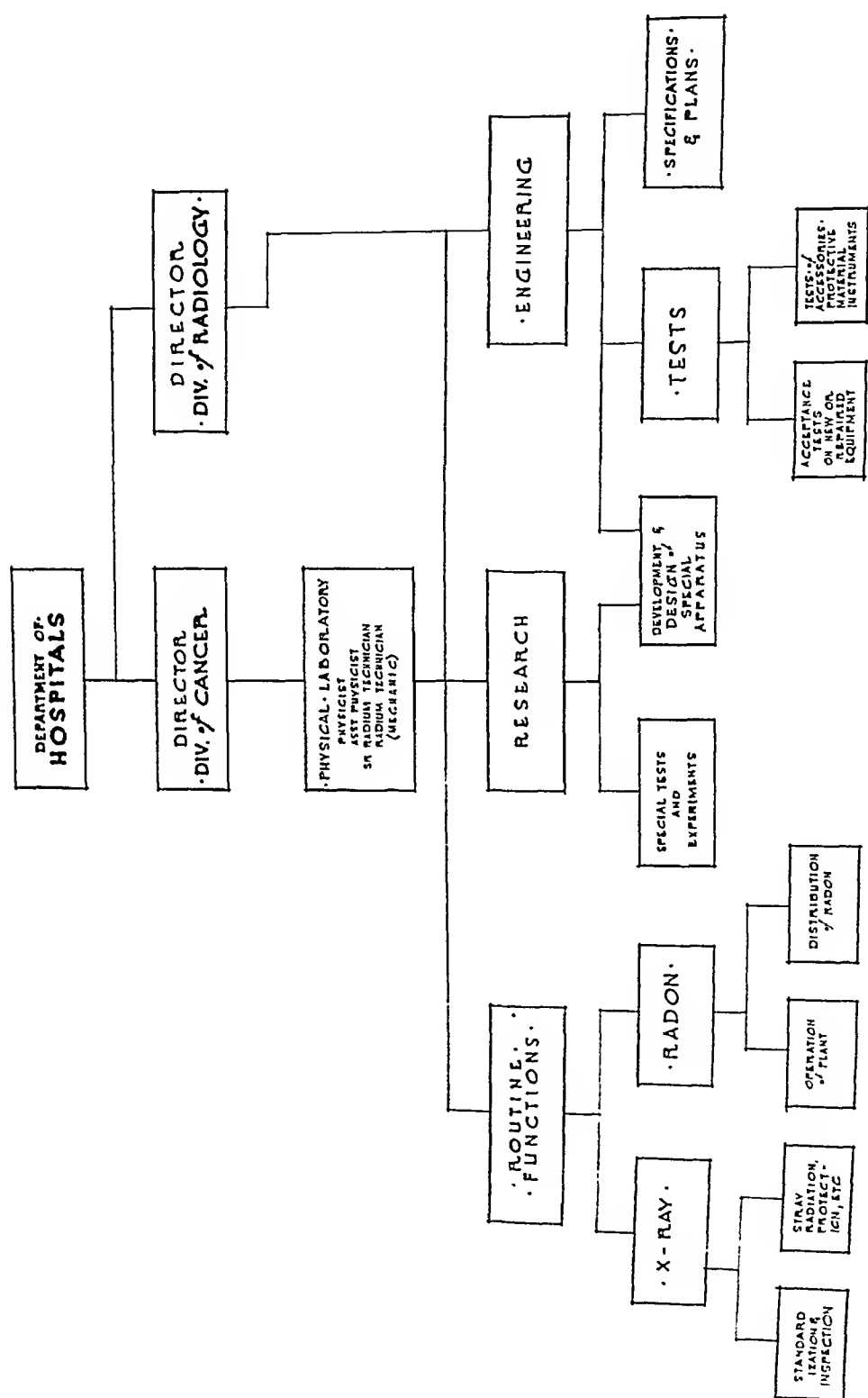


Fig. 6.

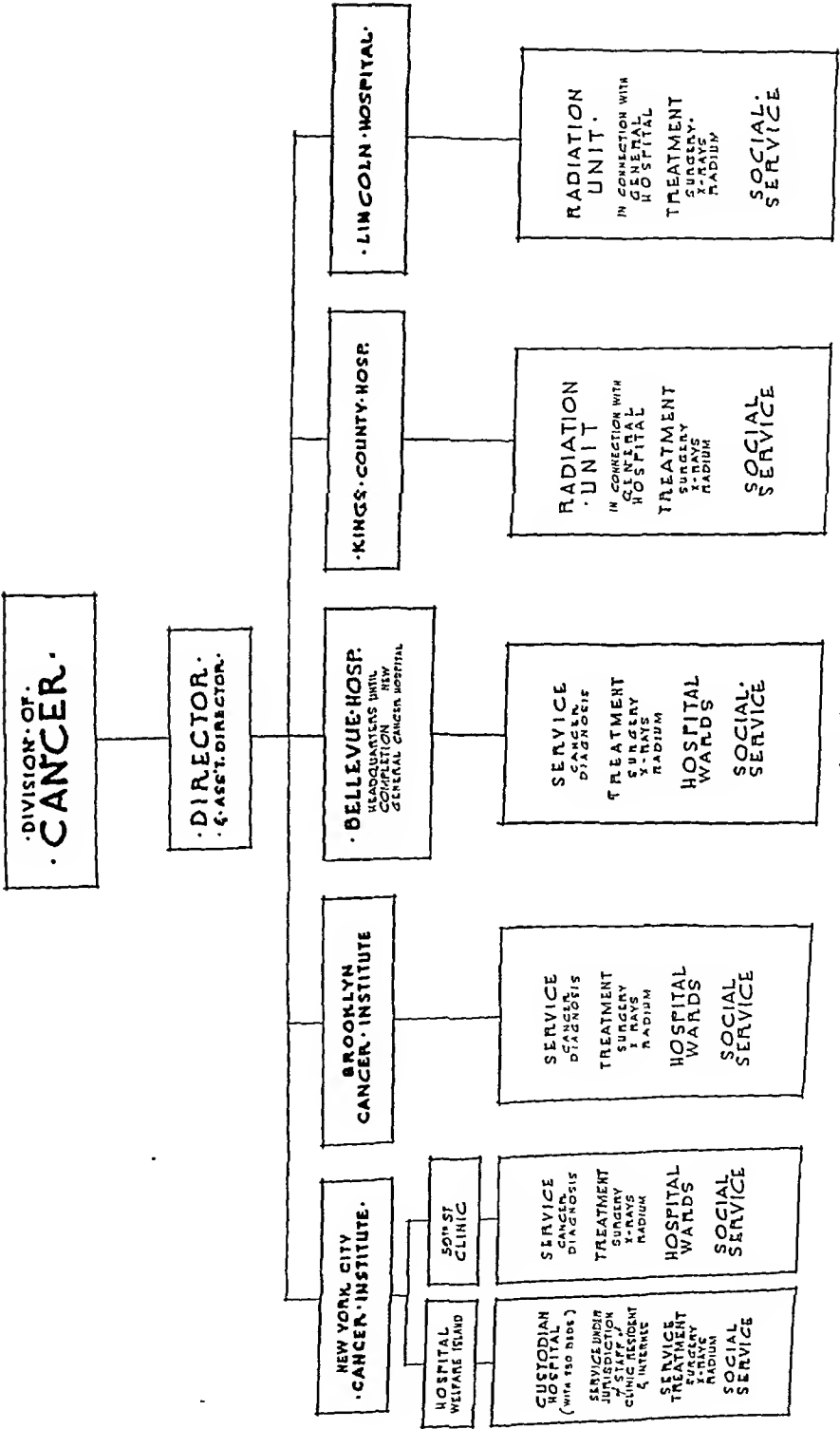


Fig. 5.

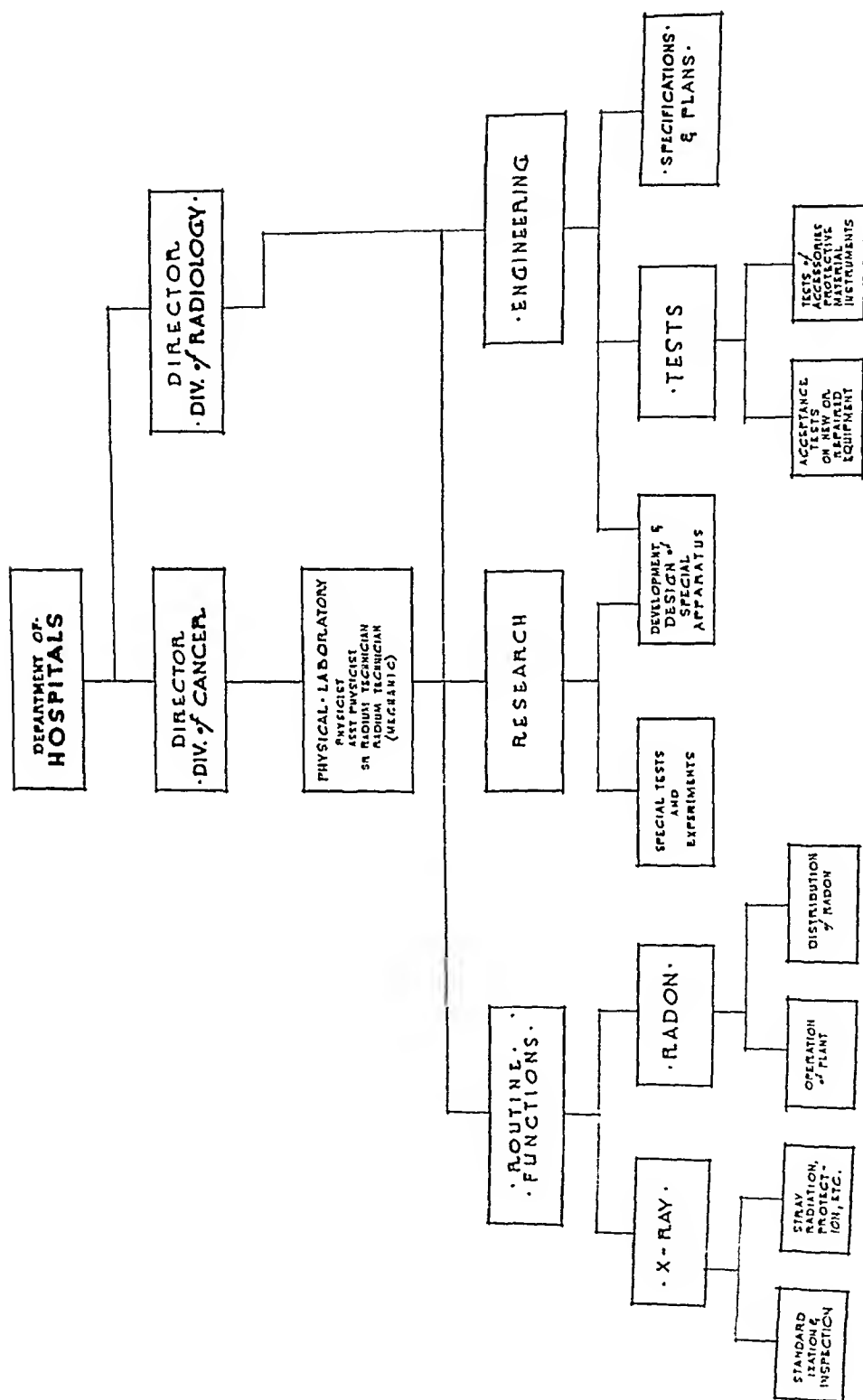


Fig. 6.

RADIATION THERAPY UNIT BELLEVUE HOSPITAL

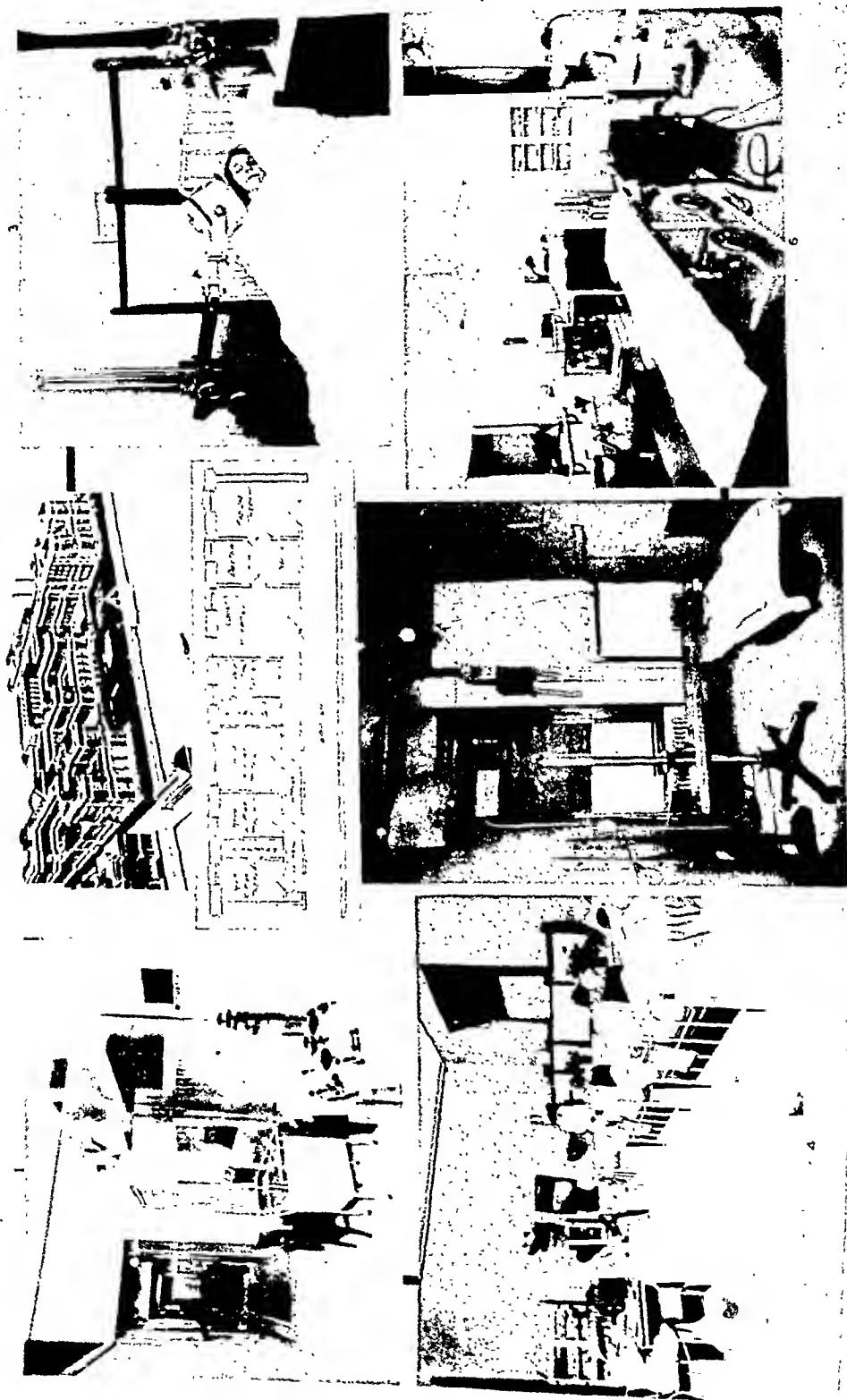


Fig. 8. (1) X-ray Therapy Department. (2) Bellevue Hospital; plan of Radiation Unit. (3) Portable Radium Pack. (4) Radium Ward. (5) X-ray Therapy Treatment Room. (6) Operating and Radium Treatment Room.

treatment of such of its patients as require hospitalization. It is manned by a regularly appointed trained staff, and is thoroughly equipped with adequate, up-to-date X-ray therapy apparatus and with a large supply of radium element.

Patients are received in this unit from the wards and dispensary of Bellevue Hospital, from other hospitals and clinics, or from physicians not attached to hospitals. Both benign and malignant conditions requiring radiation therapy are treated and those requiring institutional care are hospitalized. In connection with the Medical College, instruction in the diagnosis and treatment of cancer is given by members of the staff to both undergraduate and graduate students. This instruction is given either in an elementary form for students and general practitioners, or in an advanced course for those specializing in radiation therapy. A considerable amount of research in cancer is also carried on in co-operation with the large well equipped pathological laboratories of the hospital.

The routine procedure in caring for patients is as follows: When a patient is referred to the Radiation Department he is thoroughly examined and consultation had with the medical man, the surgeon, the pathologist, and the radiation therapist. Where possible, a biopsy is done in all accessible lesions. No radiation therapy is carried out until the proper diagnosis has been made in each case. Should surgical interference be indicated, the patient is referred to the service best able to render that form of therapy. Where radiation therapy is required, it is carried out either entirely by the radiation staff or under its immediate supervision in conjunction with other divisions of the hospital. Photographs are taken, when possible, to show the lesion before and after treatment. A follow-up observation of all patients handled by the Radiation Department is carried on through

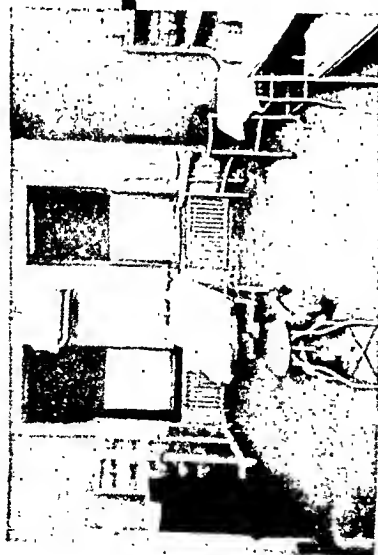
the assistance of the Social Service for Cancer. The Social Service Department maintains contact with all patients, insists upon regular attendance at the clinics for treatment, and also gives assistance in a material way to such patients as are unable during the time they are undergoing treatment to support themselves and their dependents.

The specialized cancer hospitals established by the Division are two in number at the present time, one in the Borough of Manhattan and the other in the Borough of Brooklyn. These are complete hospitals for the diagnosis, treatment, and care of cancer patients, and are manned by a full hospital staff. They have complete roentgenographic and pathological departments, offer a general medical and surgical service, and a complete radiation therapy service for the treatment and care of cancer, irrespective of the stage in which the case may be. The equipment includes adequate, up-to-date X-ray therapy apparatus, a large quantity of radium, and a suitable supply of radon from the emanation plant of the Division.

For the care of hopeless cancer cases there is a Custodial Hospital of 250 beds maintained by the Division and situated on Welfare Island. Future plans call for enlarging this hospital to enable it to care for 400 patients. It is equipped to carry on palliative treatments with surgery, X-rays, and radium. To this hospital are sent all the hopelessly involved cancer cases referred to the general municipal hospitals, and cases treated by other cancer hospitals, clinics, or physicians, in which the treatment given has failed to hinder the growth of the disease. In this custodial institution all efforts are directed towards ameliorating the sufferings of the hopeless patients confined there and to making their lingering exit from life as mercifully free from discomfort as possible. If permitted to remain idle the patients would find this period of waiting almost

DEPARTMENT OF HOSPITALS OF THE CITY OF NEW YORK

CANCER INSTITUTE 59TH STREET



Operating room at 59th Street clinic where cancer patients are cured for surgically when this method of treatment is indicated



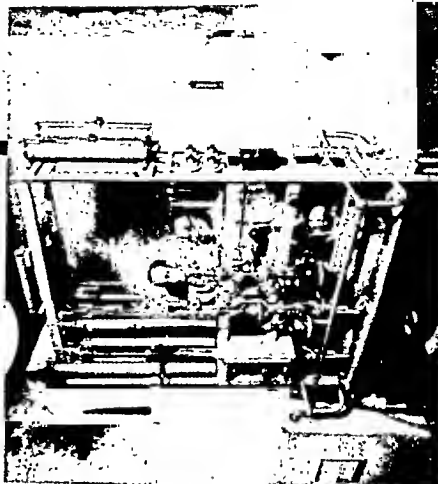
Radium Treatment room New York City Cancer Institute, 59th Street



Ward in Custodial Hospital, Welfare Island



WELFARE ISLAND



Radium emanation plant, Welfare Island

NEW YORK CITY CANCER INSTITUTE

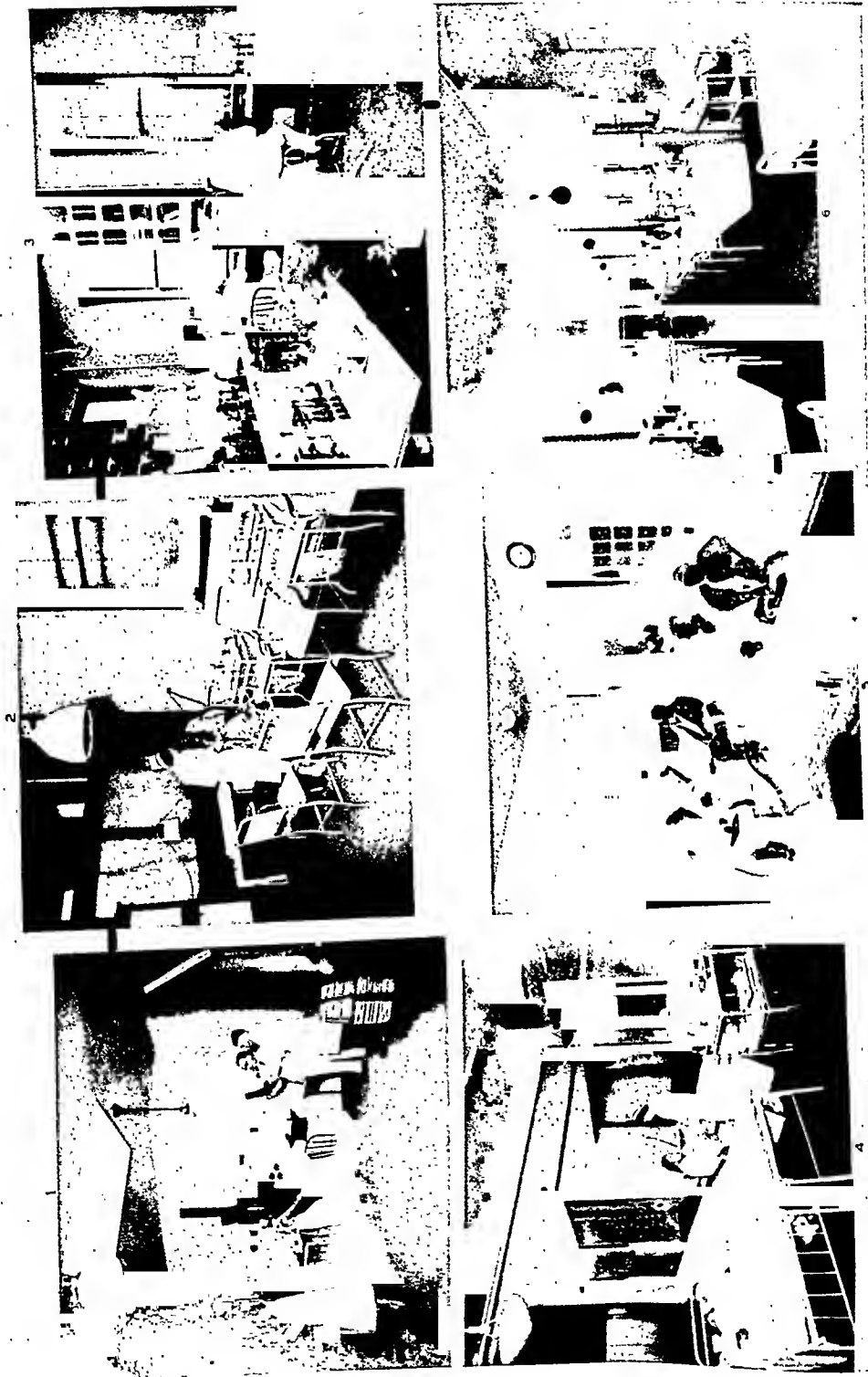


Fig. 10. (1) X-ray Therapy Department. (2) Clinic Examining Room. (3) Laboratory. (4) Cubicle Ward, Cancer Clinic. (5) Waiting Room.

unendurable, and so the Social Service Department of the Division of Cancer interests

them in various forms of occupational therapy, thereby keeping their minds occupied in

CASES REFERRED TO CANCER DIVISION TOO FAR ADVANCED FOR TREATMENT

BREAST CASES

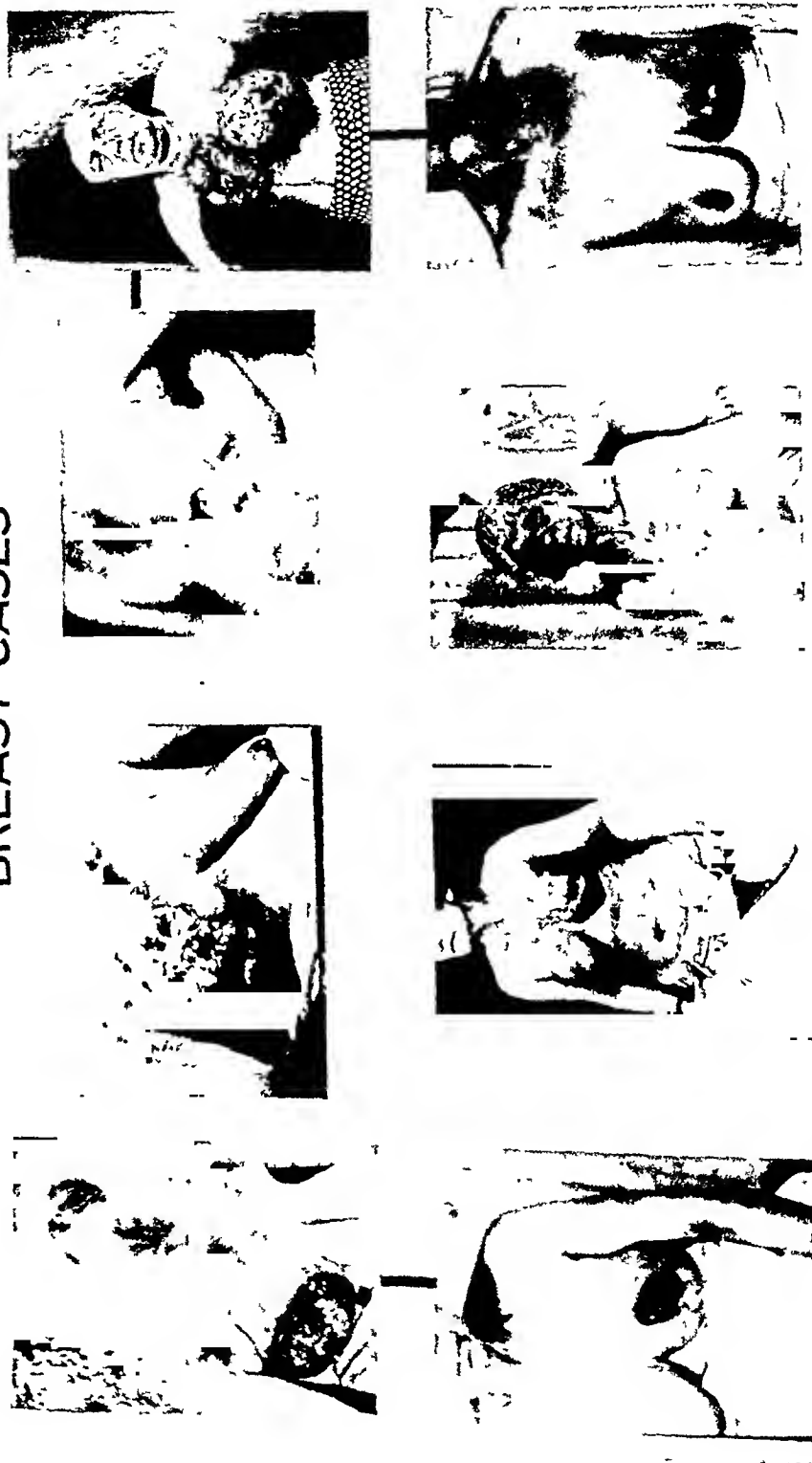


Fig. 11. Showing the type of patients referred for treatment when effective therapy can no longer be administered. All these cases have distant metastasis already present. Some of them received some sort of treatment in an earlier stage from physicians, druggists, and friends.

CASES REFERRED TO CANCER DIVISION TOO ADVANCED FOR EFFECTIVE TREATMENT

MOUTH CASES



CASES REFERRED TO CANCER DIVISION TOO ADVANCED FOR EFFECTIVE TREATMENT

FACE CASES



Fig. 13. (1, 2, and 3) Rodent ulcer of the face. (4) Parotid tumor. (5) Epithelioma of the ear. (6 and 7) Epithelioma of the face.

physical work rather than in brooding over the thought of approaching death

In carrying on its radiation work the Division adopts the methods best suited for

CASES BEFORE AND AFTER TREATMENT BY X-RAY THERAPY

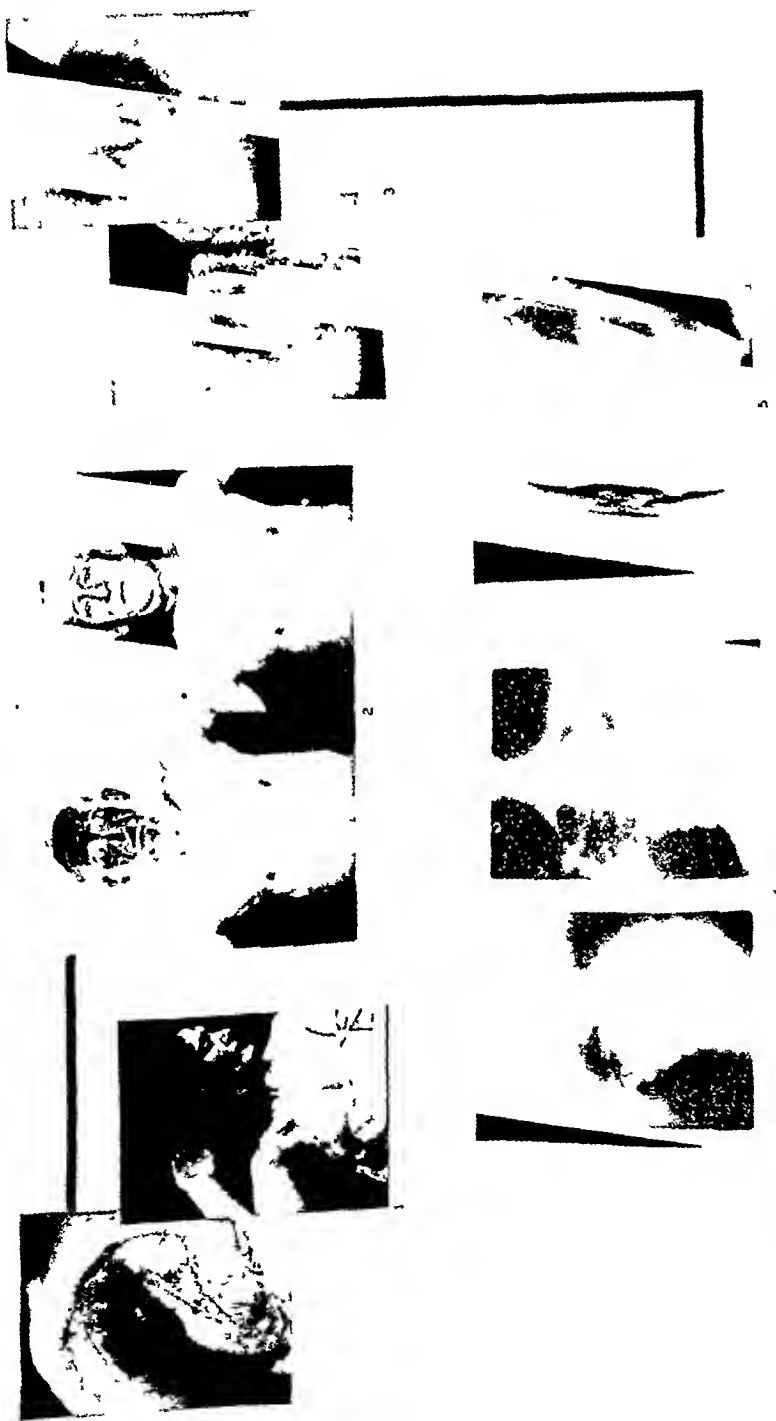


Fig 14 (1) Post-operative recurrent carcinoma of the breast before and after treatment with X-rays (2) Generalized Hodgkin's before and after treatment with X-rays (3) Condyloma of the vulva before and after treatment with X-rays (4) Lymphosarcoma of the chest before and after treatment with X-rays (5) Bone sarcoma before and after treatment with X-rays



Fig. 15. (1) Multiple hemangioma before and after treatment with radium surface applicator. (2) Hemangioma of the face before and after treatment with radium needle puncture. (3) Lupus of the face before and after treatment by endothermy and X-rays. (4) Epithelioma of the hand before and after treatment with surface radium mold. (5) Melanosarcoma of the foot before and after treatment with X-rays, surgery, and radium. (6) Sarcoma of the arm before and after treatment with X-rays, surgery, and radium.

FACE CASES BEFORE AND AFTER RADIUM TREATMENT



Fig 16 (1, 3, and 5) Cancer of the face before and after treatment with surface radium applicator (2) Cancer of the nose before and after treatment with surface radium applicator (4) Cancer of the ear before and after treatment with surface radium applicator

LIP AND MOUTH CASES BEFORE AND AFTER TREATMENT



Fig. 17. (1) Epithelioma of the lip before and after treatment with radium needle puncture. (2) Epithelioma of the lip before and after treatment with radium mold. (3) Tuberculosis of the lip before and after treatment with radium mold. (4) Epithelioma of the tongue before and after treatment with radium needle puncture. (5) Sarcoma of the mouth before and after treatment with X-rays, surgery, and radium. (6) Carcinoma of the mouth before and after treatment with X-rays, surgery, and radium.

its patients, based on the technic in use in Sweden. Moreover, it has devised special the large clinics of France, Germany, and apparatus and applicators peculiar to the

METHODS USED FOR RADIUM THERAPY

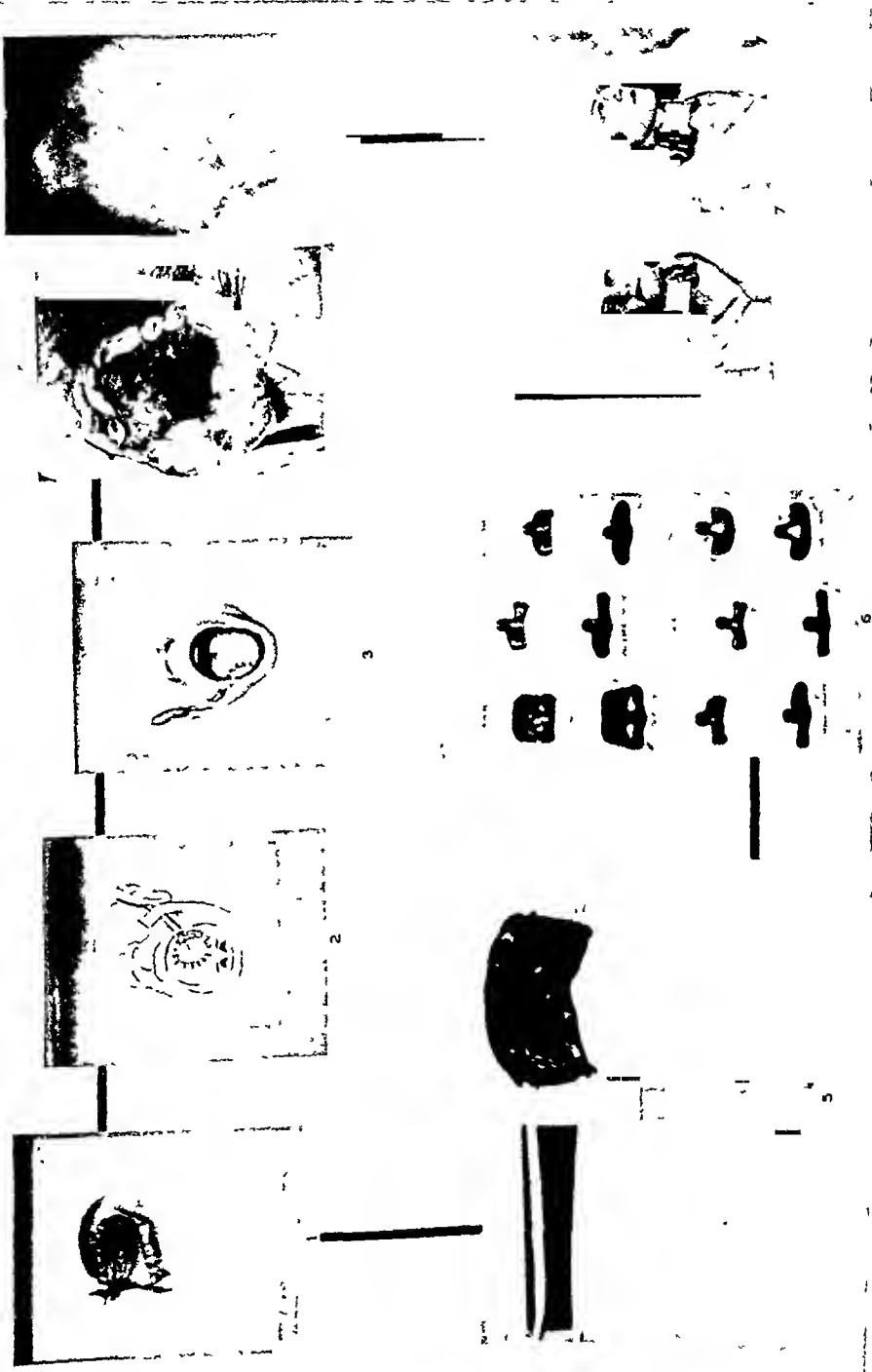


Fig. 18. Methods employed in radium therapy: (1) lesion of the cheek; (2) lesion of the tongue; (3) lesion of the palate; (4) lesion of the tongue; (5) wax for making molds; (6) various shapes made by radon wax; (7) radium mold for surface radium treatment of the thyroid.

technic of its own staff, for the treatment of cancer of the cervix, rectum, breast, and esophagus, and these have been described in contributions to the various medical journals as representing some of the scientific activities of members of the staff attached to the Division.

The City of New York owns approximately five and one-half ($5\frac{1}{2}$) grams of radium element, two grams of which are in solution for the manufacture of radon or radium emanation. The radium element is in tubes and needles of various sizes, with special long needles for the newer therapy of breast cancer. The radium emanation plant is centrally located on Welfare Island, in connection with the Custodial Hospital there.

In order to administer treatment to patients in accordance with the most modern methods, the Division of Cancer is prepared to utilize every known scientifically approved remedy. To evaluate proffered cancer cures, the Division accepts for testing all such proposed remedies. For this purpose there has been established in the Division of Cancer, a Cancer Cure Committee, composed of a pathologist, a surgeon, a physicist, a radiation therapist, and the Division Director, which Committee examines all submitted cures, passes upon their value, and decides upon the advisability of their being tried in the treatment of the city's patients. In connection with its work this Committee has set up the following criteria by which all proposed cures are judged and to which they must conform: (1) The constituents or ingredients must be disclosed; (2) a substantial quantity must be supplied to the Committee for the purpose of proper testing; (3) the tests are to be carried out under the jurisdiction of the Committee on the Cancer Division service; (4) the tests are to be made only on patients pathologically proven to have a malignancy; (5) if the cure proves efficacious, it must be made freely available

for use by the Division of Cancer and by the profession at large, due credit being given the originator; (6) the Committee reserves the right to publish all facts regarding the tests.

During the past few years the Division has received and tested a great many so-called cures, but unfortunately none has been found to have real value. No methods or substances offered for superficial treatment of cancer present any superiority over those tried remedies—surgery, X-rays, and radium. The biological cures offered have in our hands proven useless.

An integral part of the Division is the Department of Physics, organized to standardize the radiation work of the constituent units of the Division. This special department, staffed by trained physicists, tests all apparatus in the X-ray departments of all the hospitals in the municipal system, makes all necessary physical measurements required for standardizing the apparatus, has charge of the Radium Emanation Plant and of the planning of new buildings, apparatus, etc., for the entire Division. All X-ray therapy apparatus used is standardized according to the biological and also the International X-ray Unit. This department also conducts (scientific) research, experiments, and studies in the physics of radiation.

Experience has shown that to reduce the incidence of cancer, everything possible must be done to prevent transition from precancerous lesions to a fully developed cancer condition. This is made possible by reducing the hazards of constant irritation, infection, and trauma, that, so far as is known at present, are the causative agencies for cancer. To effect this object, the Division of Cancer has joined with medical and quasi-medical societies for the requisite education of the public, and the far-spreading campaign is carried on by means of public lectures, radio talks, and health meetings. Re-

SET-UPS FOR VARIOUS RADIUM TREATMENTS

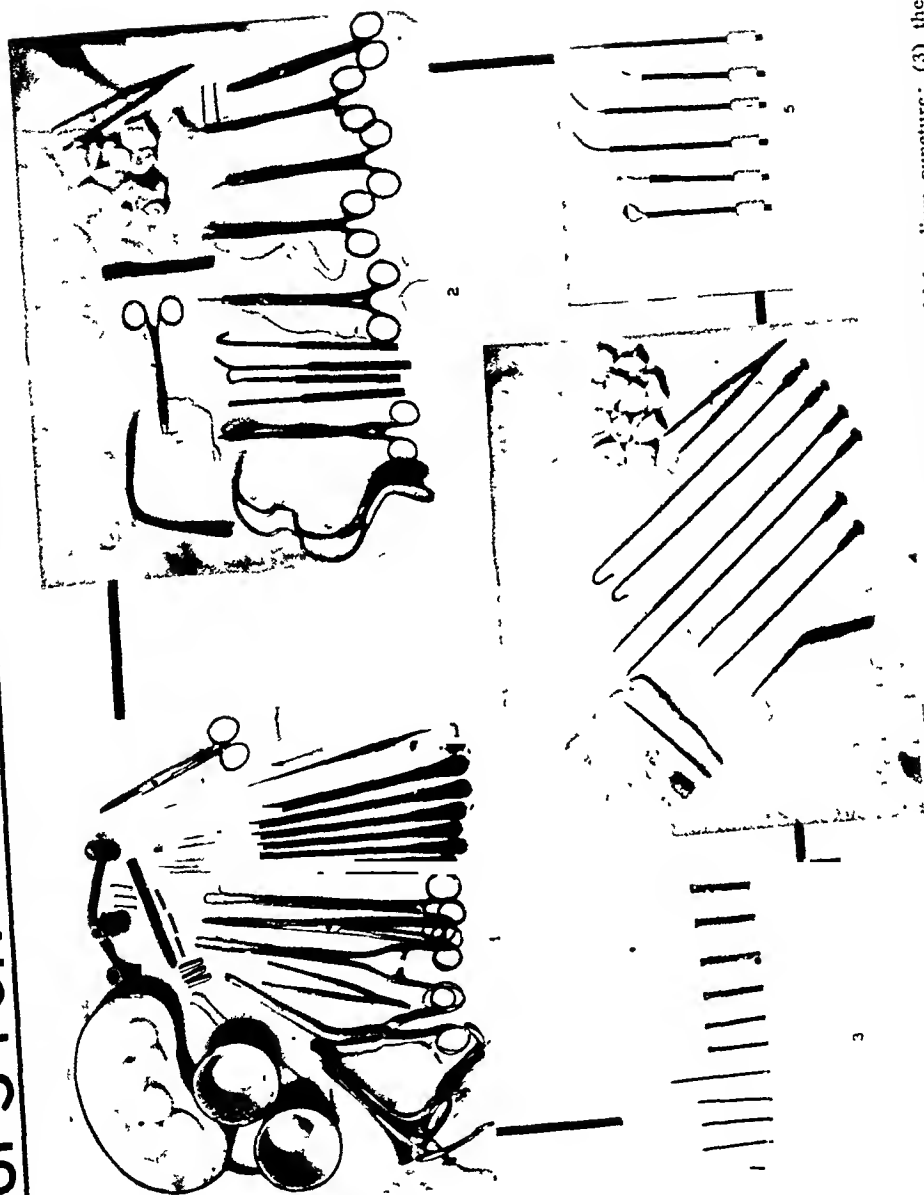


Fig. 19. Instrument set-up used for radium treatment: (1) gynecological; (2) for interstitial radium puncture; (3) the forms in "choc." (4) instruments used for radon tubules (seeds) implantation; (5) special endotherm cut-

METHOD OF TREATMENT OF CARCINOMA OF CERVIX AND RECTUM

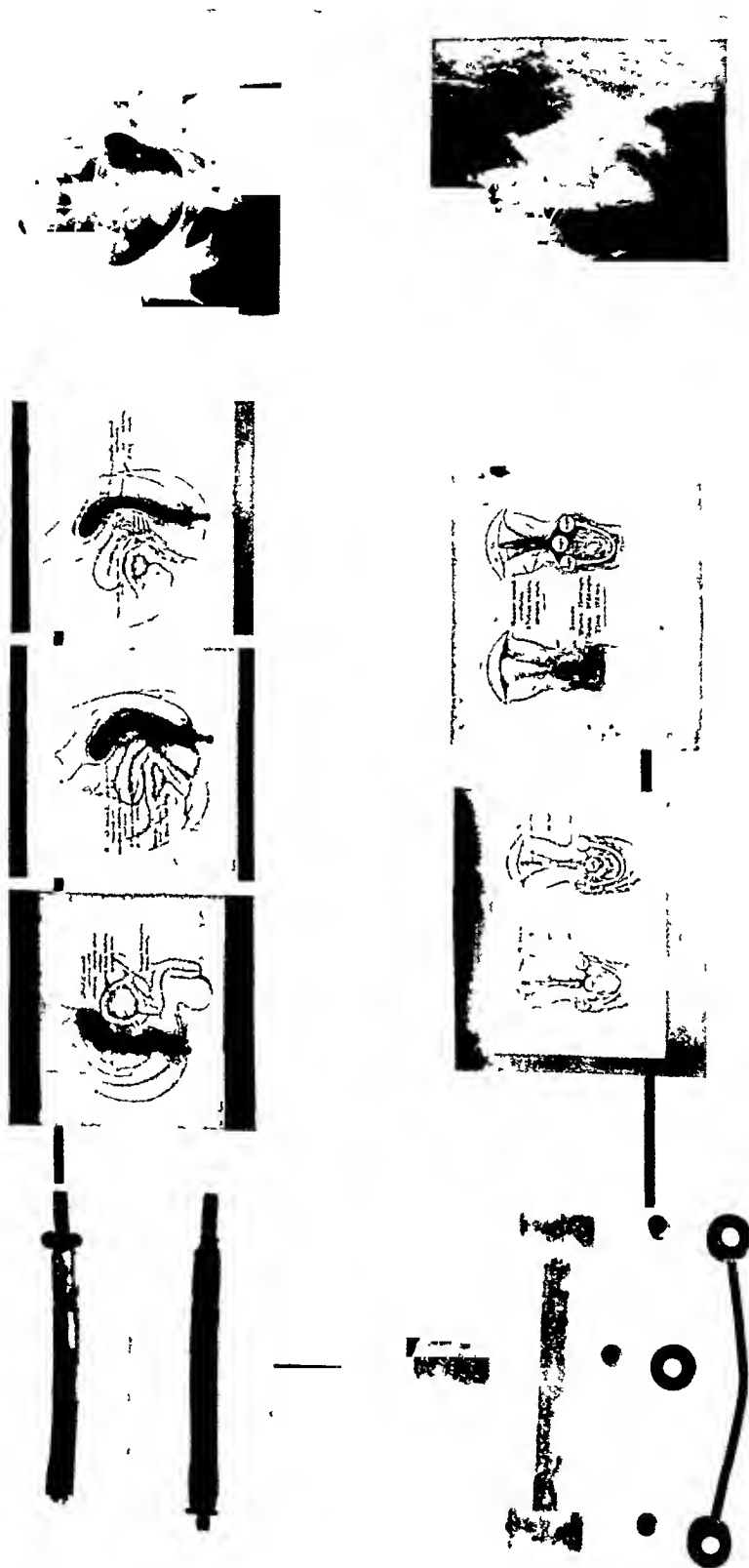


Fig. 20. Cancer of the cervix is best treated by irradiation—a combination of high voltage X-rays through the pelvis and an application of radium to the uterus and vagina is the proper procedure. Special applicators, such as the colpostat, have been devised for the convenient application of radium to the cervix. In the treatment of cancer of the rectum, radium plays an important part. A new device for applying heavily filtered radium to the surface of a malignant lesion in the rectum has proven of value in our work.

sults, while slow, have nevertheless been increasingly gratifying.

To summarize, the City of New York cares for its cancer patients through the Division of Cancer, a bureau of its general hospital system. This Division concerns it-

self with the diagnosis, care, and treatment of cancer patients in hospitals and clinics, and with educating the profession as well as the lay public in cancer work.

The accompanying photographs illustrate some of the activities of this Division.

The Permeability of Cloth Material for the Spectrum of the Sun. W. Mörikofer. *Strahlentherapie*, 1930, XXXIX, 57.

The transparency of twenty-two different types of cloth material for the sun spectrum was studied by means of the cadmium photo-electric cell and by the Michelson-Bimetal actinometer. The transparency of the various materials varied considerably with their texture. It appeared, for instance, that jersey material has a great transparency, while flannel and heavier cloth are almost impermeable. No simple relations could be established between the transparency for light and the weight, the thickness, and the pore volume of the cloth. Boiling decreases or increases the transparency and sometimes does not influence it much. Dyed cloth has less transparency than white cloth. Only the transparency of

artificial silk is increased by the dyeing process. Black cloth transmits less radiation than red or blue cloth. There is no selective absorption for different parts of the spectrum in undyed material. Longer waves are transmitted better by red material, while the shorter waves are better transmitted by blue material; the difference, however, is very slight. It is concluded that the major part of the radiation must pass through the pore openings and that very little is transmitted by the actual material. In addition to the directly transmitted radiation, there is also some diffuse radiation which amounts sometimes to only a small fraction of the direct radiation, except for material of little permeability. The dyeing process leads to a decrease of the transparency for diffused radiation, in some cases as far as complete impermeability.

ERNST A. POHLE, M.D., Ph.D.

ROENTGEN THERAPY OF MEDULLOBLASTOMA CEREBELLI

By F. E. TRACY, M.D., and F. B. MANDEVILLE, M.D.
From the Department of Radiology, Yale University, NEW HAVEN, CONN.

IN 1924, Bailey and Cushing (2) presented a series of twenty-nine centrally placed cerebellar tumors, arising from above the roof of the fourth ventricle and occurring mainly in children. For these tumors, they proposed the term "medulloblastoma," and submitted evidence that they were composed mainly of indifferent cells, analogous to those described by Schaper in the developing cerebrum, and that most of these cells are potential neuroglia. At that time, they concluded that the best method of treatment consisted of a suboccipital decompression followed by persistent roentgen-ray therapy. The technic of this proposed therapy was not outlined in their first paper, which was not actually published until 1925. Bailey, in the same year, individually wrote another paper on the results of roentgen therapy on brain tumors.

Olivecrona and Lysholm (8), in 1926, published excellent notes on the roentgen therapy of gliomas of the brain. One of the tumors reported by them seemed to have all the characteristics of a medulloblastoma and it reacted favorably to radiation.

In 1928, Bailey, Sosman, and Van Dessel (4) outlined a technic of irradiation which they had employed during an eight-year period, in 456 patients with brain tumors. Of these, 222 had been classified as "gliomas" but they limited their considerations to 62 cases, and of these 12 were medulloblastomas. All treatments in their department had been given with an interrupterless 12-inch transformer, mechanically rectified, using 130 to 140 K.V. peak. According to the authors, the filter most often employed was 0.25 mm. of rolled copper, with one thickness of sole leather on the side next to the patient and occasionally 5.0 mm. of aluminum was used in place of the copper.

A distance of 12 inches (30 cm.) from the center of the target to the skin surface, occasionally 10 inches when a shorter duration was expedient, or 16 inches when a more uniform depth dose was required, was used. The portals of entry were delimited by lead rubber on the patient's head and by various lead diaphragms $\frac{1}{4}$ inch thick placed beneath the tube, which was of the broad focus Universal Coolidge type. The authors stated that the portals varied between 8 and 15 cm. in diameter, the milliamperage was 6, and the usual time for a full dose was 25 minutes, which would produce epilation in practically all cases, but only a faint erythema occasionally, appearing in from ten to fourteen days. Such a dose could be repeated at intervals of three weeks, usually with a return of hair several months after the treatments were stopped, and with never more than slight tanning at any time. They included physical data concerning their dose, which we take the liberty to repeat here. The average effective wave length with a Duane ionization chamber was 0.21 Ångström unit as determined by the half absorption method in copper, and an average intensity at 12 inches of from 0.54 to 0.66 electrostatic unit. This gave a single full dose of from 800 to 1,000 electrostatic-unit-seconds, which included the secondary radiation as measured at skin surface. In water phantom, the depth dose with these factors was found to be from 17 to 21 per cent at a distance of 10 cm. below the surface, depending on the size of the portals. Bailey, Sosman, and Van Dessel further stated that the general plan of treatment was to use a single portal, single seance method in post-operative cases, with a trial dose of from 60 to 80 per cent the first day, repeating with 100 per cent doses once every three weeks

if no serious reaction ensued. Most of their cases, they state, received from four to eight such treatments, with a repetition of four more after an interval of from three to six months. The single area treated in each case was directly over the tumor and usually through the operative field, although they state that in deep or midline tumors, bilateral portals were used with 100 per cent of the above dose on each side in two succeeding days. The portals used were always larger than the tumor found or suspected, in order, as the authors explain, to reach it all and to obtain more secondary radiation. Of the 62 gliomas, radium was used only in five cases with varying technics. In their summary, the authors stated their belief that roentgen therapy had been able to retard the growth of medulloblastomas, sometimes for a considerable period, but that it had been unable to destroy them completely or indefinitely to prevent their growth. The fact that the average survival of their treated cases was thirty-four months was considered by Bailey, Sosman, and Van Dessel conclusive evidence of the beneficial effects of radiation.

Up to June, 1929, Bailey (1) had observed 34 new cases of medulloblastoma, in addition to the 29 previously reported in Cushing's collection. In a paper published in 1930, he stated that roentgen therapy was able to prevent local recurrence for long periods of time, and he cited a case in which necropsy showed no local recurrence but extension of the tumor elsewhere. Radiation over the entire spinal canal, in the hope that possible intraspinal extension might be killed before it began to develop, was advocated. Bailey's further experience with medulloblastomas had not altered in any way his conception of their structure or clinical course since his work with Cushing in 1924. In cases in which fairly complete enucleation and intense roentgen-ray therapy were instituted, patients died from intraspinal and intracranial extension. This ex-

tension may occur without operation but it is most frequently noted following operative interference. Bailey's conception is that the neoplastic cells are scattered into the cerebrospinal spaces by the operator, the cells falling by gravity into the spinal canal or being carried upward by the current of fluid over the base of the brain, where they grow as implantation metastases. He believes it advisable to radiate thoroughly the entire cerebrospinal system following operation, in the hope of killing scattered cells before they have time to implant themselves, for, once they have become implanted and give rise to symptoms, a fatal outcome is inevitable. He further points out that roentgen rays, in the doses used, are not supposed to injure the normal nervous tissues or meninges, and that the presence of neoplastic cells in the meshes of the pia-arachnoid gives rise to chronic irritation and proliferation of this tissue, in which condition it may be more sensitive to radiation. He believes that radiation may transform tumor-infiltrated leptomeninges into dense fibrous bands, which may constrict the cord and nerves and diminish the circulation of the blood and block the circulation of the cerebrospinal fluid. We quote the final paragraph of Bailey's paper *verbatim*, as we feel it merits the thoughtful consideration of every careful radiation therapist:

Under these circumstances one might ask whether these patients have not been given too much roentgen treatment. Would it not be better to radiate thoroughly the entire cerebrospinal axis immediately after operation, and then stop? Time and further experience alone can tell.

CLINICAL CASES

During the year 1930 three cases of medulloblastoma cerebelli were referred to us by the Surgical Service of the New Haven Hospital for roentgen-ray therapy. All

had a pre-operative diagnosis of probable medulloblastoma cerebelli, each of which was confirmed at operation by gross appearance of the tumor and later by histologic sections. At present these patients are all living and apparently symptom-free, carrying on the activities in which they were occupied before the onset of their illnesses.

ROENTGEN TECHNIC

All therapy was given with a transformer, mechanically rectified, using an air-cooled Coolidge deep therapy tube. The factors used in our continuous exposure to produce our standard erythema were: 170 kilovolts, 5 milliamperes, 0.5 mm. copper and 2 mm. aluminum, 50 cm. target-skin distance, 50 minutes, with a field of 100 square centimeters. The apparatus was calibrated by physicists only once during the period our patients were under treatment. The chemical method described by Quimby and Downes in 1930 was used, and with the above factors the equipment gave 13 r per minute, or a total of 650 r (in air). Using a field of 100 square centimeters and other factors as given above, the depth dose at 5 cm. was estimated to be 65 per cent and at 10 cm., 32 per cent.

In all three cases 100 per cent of an erythema skin dose was delivered to all portions of the entire cerebrospinal system, and by this we mean 100 per cent E.S.D. depth dosage, obtained by aid of charts advocated by Weatherwax and Widmann (11). In Cases 1 and 2, listed below, 100 per cent E.S.D. each was delivered to the right and left occipital regions, and doses varying from 25 per cent E.S.D. to 100 per cent E.S.D. were delivered to the anterior superior cranial, right and left parietal and cervical, dorsal and lumbar vertebral portals.

After treating Cases 1 and 2 with what amounted to a fractional method except for the intensive doses in the occipital regions,

we consulted independently, Pfahler (10) and Gershon-Cohen (6). Both these radiologists suggested thorough radiation of the entire cerebrospinal axis. Both were in accord in stating that the saturation method as laid down by Pfahler might be used in cases of medulloblastoma cerebelli. The saturation method was pointed out to be especially advantageous in obtaining a 100 per cent depth dose to all portions of the spinal cord where cross-firing is not convenient.

We have listed the total dosages given in Cases 1 and 2 in which the intensive method was used over the primary site (occiput) of the lesions and the fractional method essentially was used over other areas. In Case 3, 50 per cent E.S.D. was used and all areas were brought to 100 per cent E.S.D. and maintained there for one week. The patient returned in three months and was given 50 per cent E.S.D. to all portals, and this was repeated three months later. Possibly we have been entirely too cautious with Case 3, but we are reminded of Bailey's suggestion, "Would it not be better to radiate thoroughly the entire cerebrospinal axis, immediately after operation, and then stop?" Further, it must be kept in mind that after the decompression operation the patient can stand heavy total dosages, but when the decompressive effects are spent, even a 50 per cent E.S.D. delivered over the occipital portal will cause vomiting which will last for days. This was our experience with Case 2.

We cannot stress too strongly the point that thorough roentgen therapy must not be attempted without a suboccipital decompression, and, secondly, that the effects of a decompression do not last for long, and vary in different cases.

CASE REPORTS

Case 1. A female, aged 13 years, was admitted to the Surgical Service of the New Haven Hospital on July 18, 1929. The past history until two months before admission

if no serious reaction ensued. Most of their cases, they state, received from four to eight such treatments, with a repetition of four more after an interval of from three to six months. The single area treated in each case was directly over the tumor and usually through the operative field, although they state that in deep or midline tumors, bilateral portals were used with 100 per cent of the above dose on each side in two succeeding days. The portals used were always larger than the tumor found or suspected, in order, as the authors explain, to reach it all and to obtain more secondary radiation. Of the 62 gliomas, radium was used only in five cases with varying technics. In their summary, the authors stated their belief that roentgen therapy had been able to retard the growth of medulloblastomas, sometimes for a considerable period, but that it had been unable to destroy them completely or indefinitely to prevent their growth. The fact that the average survival of their treated cases was thirty-four months was considered by Bailey, Sosman, and Van Dessel conclusive evidence of the beneficial effects of radiation.

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weakness, nystagmus to gaze in all directions with quick component most marked to left, hypertonia of right upper extremity, ataxia, Romberg positive to right and adiadochokinesia right. The pre-operative diagnosis was medulloblastoma involving the roof of the fourth ventricle and the right hemisphere of the cerebellum. A suboccipital decompression was done by Dr. German on October 6, 1930, with partial removal of a fourth ventricular tumor involving also the right cerebellar hemisphere. On October 20, 1930, deep roentgen therapy was begun. The usual areas were treated by the saturation method, as introduced by Pfahler, for a one-week period, so that the dosage was kept at 100 per cent E.S.D. over each area during this time. The areas thus treated on the skull measured 10 by 10 cm. approximately, and those over the spine 18 by 5 cm. approximately. The patient was discharged November 6, 1930, greatly improved. He returned January 16, 1931, for more deep roentgen therapy and was given a 50 per cent dose to each portal, and this procedure was repeated three months later, making the total dosage for each area as given below. At no time did the patient show any untoward effects from his roentgen therapy and on his last visit it was noted that the hair over his entire scalp had regrown.

Anterior superior skull.....	250 per cent
Posterior occipital and cervical spine	250 per cent
Right lateral skull.....	225 per cent
Left lateral skull.....	225 per cent
Dorsal spine.....	250 per cent
Lower dorsal and lumbar spine....	257 per cent

The areas given above seem most satisfactory for treatment of brain tumors—primary or metastatic. We have used this method routinely in our latest cases, including a fourth case of medulloblastoma, with good immediate results. The ultimate results must be determined at a future date,

and this paper should be considered as a preliminary report.

SUMMARY

1. Our object is to again bring to the attention of radiologists the work of Bailey and Cushing on the medulloblastomas, the more important part of which remains hidden in the neurologic and pathologic literature.

2. Medulloblastomas are usually centrally placed cerebellar tumors arising in the region of the roof of the fourth ventricle and occur mainly in children. They are so common in pre-adolescence that when a child has unexplained vomiting, shows a possible enlargement of its head, and gives a story of periodical unsteadiness, it is well to be on guard and look at the eye grounds frequently.

3. A suboccipital decompression should always precede roentgen therapy, and the beneficial effects vary tremendously in duration.

4. The advisability of suboccipital decompression alone, or, in addition, partial or total extirpation of the tumor, is a surgical and not a radiological problem in each individual case.

5. Thorough deep roentgen therapy over the entire cerebrospinal system should follow operation. A minimum total depth dosage of 100 per cent E.S.D. to all parts of the cerebrospinal system is indicated.

6. After the first complete cycle of roentgen therapy, the saturation method or a complete repetition of the cycle, two, three, or four times may be indicated during the first twelve months, according to the individual case.

7. The radiologist should exercise great caution in attempting to continue the roentgen therapy for too long a period, as the tumor cells probably become radioresistant and further radiation may damage surrounding tissues and adjacent organs.

was negative, at which time she began to have fronto-occipital headaches. Two weeks before admission she began to have slight blurring of vision, diplopia, projectile vomiting, and slight unsteadiness of gait. The above symptoms increased in severity and confined the patient to her bed for one week previous to her entrance to the hospital. The essential positive findings on neurological examination were: Bilateral papillo-edema, left internal strabismus, positive Romberg to the right and equivocal left Babinski. The pre-operative impression was a fourth ventricle medulloblastoma. On July 22, 1929, a cerebellar exploration was done by Dr. Harvey, revealing a tumor of the fourth ventricle. On August 6, 1929, a second operation was done and a partial extirpation of the tumor mass was made. The patient was discharged from the hospital August 29, 1929, much improved. She returned for roentgen-ray therapy December 19, 1929, receiving deep roentgen therapy for a period of fourteen months with no untoward effects and apparently no recurrences of symptoms. The areas treated, with total percentage to each area, are as follows:

Anterior superior parietal region.....	100 per cent
Left parietal region.....	100 per cent
Right parietal region.....	175 per cent
Posterior occipital region (left).....	400 per cent
Posterior occipital region (right).....	405 per cent
Nape of neck and cervical spine	
(left)	325 per cent
Nape of neck and cervical spine	
(right)	320 per cent
Upper dorsal region.....	450 per cent
Lumbar spine.....	250 per cent

Case 2. A female, aged 6 years, was admitted to the Surgical Service February 18, 1930, complaining of vomiting, headaches, and unsteadiness of gait. These symptoms began seven months previously and, more recently, there had been some blurring of vision. The positive findings on neurological

examination were: Bilateral papillo-edema, horizontal nystagmus of cerebellar type, slight bilateral adiadokocinesia, hypotonia, unsteady gait, and broad base stance. The pre-operative impression was of a medulloblastoma arising in the roof of the fourth ventricle and involving the cerebellum. On February 22, 1930, the cerebellar fossa was explored by Dr. German and a large tumor mass was found in the left cerebellar hemisphere extending medially into the fourth ventricle. It was partially extirpated. The first cycle of deep roentgen therapy was given between March 11 and 20, 1930, and the patient was discharged from the hospital March 21, 1930, much improved. During the course of the next twelve months the patient returned to the hospital at intervals for deep roentgen-ray therapy. The following areas were treated with the total percentages given below. There has been no return of symptoms.

Anterior superior parietal region..	60 per cent
Left parietal.....	110 per cent
Right parietal.....	110 per cent
Posterior occipital region (left).....	200 per cent
Posterior occipital region (right).....	200 per cent
Nape of neck and cervical region	
(left)	345 per cent
Nape of neck and cervical region	
(right)	320 per cent
Upper dorsal region.....	410 per cent
Lower dorsal and lumbar spine.....	275 per cent

Case 3. A male, aged 15 years, was admitted to the Surgical Service October 1, 1930, complaining of headaches, projectile vomiting, blurring of vision, and unsteady gait. The onset of symptoms was in July, 1929, when the patient first began to have headaches. Since then the above symptoms developed and progressed in severity until the patient became confined to bed (one month before entrance to the hospital). The essential findings on examination were: Bilateral papillo-edema, right external rectus

weakness, nystagmus to gaze in all directions with quick component most marked to left, hypertonia of right upper extremity, ataxia, Romberg positive to right and adiadokocinesia right. The pre-operative diagnosis was medulloblastoma involving the roof of the fourth ventricle and the right hemisphere of the cerebellum. A suboccipital decompression was done by Dr. German on October 6, 1930, with partial removal of a fourth ventricular tumor involving also the right cerebellar hemisphere. On October 20, 1930, deep roentgen therapy was begun. The usual areas were treated by the saturation method, as introduced by Pfahler, for a one-week period, so that the dosage was kept at 100 per cent E.S.D. over each area during this time. The areas thus treated on the skull measured 10 by 10 cm. approximately, and those over the spine 18 by 5 cm. approximately. The patient was discharged November 6, 1930, greatly improved. He returned January 16, 1931, for more deep roentgen therapy and was given a 50 per cent dose to each portal, and this procedure was repeated three months later, making the total dosage for each area as given below. At no time did the patient show any untoward effects from his roentgen therapy and on his last visit it was noted that the hair over his entire scalp had regrown.

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Posterior occipital and cervical spine	250 per cent
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Dorsal spine.....	250 per cent
Lower dorsal and lumbar spine....	257 per cent

The areas given above seem most satisfactory for treatment of brain tumors—primary or metastatic. We have used this method routinely in our latest cases, including a fourth case of medulloblastoma, with good immediate results. The ultimate results must be determined at a future date,

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The Rôle of Roentgenology in Psychiatry. M. J. Hubeny. *Clin. Med. and Surg.*, March, 1931, XXXVIII, 191.

A short discussion is presented concerning the new studies of the causes of insanity. The use of information obtained from the roentgenologic examination and the treatment of such cases are described. Thyrotoxicosis, the climacteric, uterine fibroid, thymic disease, dystrophia, adiposo-genitalis, and other allied anatomic and physiologic conditions are mentioned. An effort is made to stimulate more observations so that proper consideration may be given the insane.

A. O. HAMPTON, M.D.

Roentgen Diagraphic Examination of Muscle Contraction. Gundo Boehm. *Med. Klinik*, Sept. 12, 1930, XXVI, No. 37, p. 1372.

Roentgendiagraphy is a means of showing the spacing of the molecules and their changes in biological objects. This method shows a characteristic system of points or

lines on a film, when a small bundle of X-rays of definite wave length passes through a given substance. A crystal gives a point diagram, according to Laue; a crystal-powder gives a line diagram. The muscle gives also a characteristic diagram. Comparison between roentgen diagrams of muscles of turtles before and during contraction shows marked differences, indicating a definite change in the molecular structure. Further studies along this line may be of importance in the physiology of muscle contraction.

H. W. HEFKE, M.D.

Davos. A. Jesionek. *Strahlentherapie*, 1930, XXXIX, 1.

This article, the first in a volume, dedicated to C. Dorno, offers a concise analysis of the climatic factors of Davos and their curative effects. The beneficial results obtained in tuberculosis are, in the author's opinion, mainly due to the Alpine sun, which is very rich in the ultra-violet part of the spectrum.

ERNST A. POHLE, M.D., Ph.D.

RESULTS OF IRRADIATION TREATMENT OF MYOMA OF THE UTERUS

BASED ON A STUDY OF 318 CASES

By BERNARD F. SCHREINER, M.D., F.A.C.S.

State Institute for the Study of Malignant Disease, BUFFALO, N.Y.,
Burton T. Simpson, M.D., Director.

IT is not the purpose of this paper to discuss the different forms of treatment for fibroids of the uterus, but, rather, to lay stress on the proper irradiation and the results obtained therefrom.

There has been much controversy between the gynecologist and the radiologist about the proper course of treatment of very large myomas. The gynecologist holds that a tumor larger than a four-months pregnancy should be subjected to surgery, while the exceptions to this rule are common in the hands of many competent radiotherapists. The surgical treatment of the myoma and the control of the bleeding by hysterectomy have well known indications which from the surgical point of view are well recognized. The results of treatment are definite. The operative mortality, in good hands, is from 1 to 5 per cent. The morbidity is a factor which often is disregarded by the gynecologist but is a potent factor to the patient and the physician. There are, without doubt, cases that can be handled to better advantage by surgical intervention, but the value of irradiation is very definite, having advantages of no loss of time and no mortality.

In our series of cases, the fibroids varied from about twice the size of a normal uterus, nodular, up to the size of an eight- to nine-months pregnancy. About 92 per cent of the growths occurred in the body of the uterus, only 8 per cent in the cervix. All varieties and combinations were observed; submucous, interstitial, and subserous, a few of the latter being pedunculated.

Ewing (1) says that 50 per cent of women at the age of 50 have fibroids, 20 per cent at the age of 35, and 38 per cent be-

tween the ages of 30 and 40, and quotes Klob and Gusserow as authority. He holds that:

The essential factor in the etiology of myoma is an embryogenic disturbance in the structure of the uterus. The remarkable degree of isolation of many myomas, their widespread occurrence apart from the uterine body, and the presence in many cases of heterotopic inclusions, epithelial, cartilaginous, osseous, fatty, and rhabdomyomatous, clearly point to an embryonal origin. Moreover, as Williams has emphasized, uterine myomas are often associated with a large number of abnormalities in the genito-urinary system.

The nature of the embryogenic disturbance varies with different tumors.

(a) It is generally agreed that the common pure fibromyoma results from a disturbance in the formation of the tubes, uterus, and vagina from the müllerian ducts, which split off from the wolffian ducts at an early period, and fuse to form the genital canal.

The relation of certain early myomas to the blood vessels of the uterus has long impressed many observers, and suggested that uterine myomas arise from disturbances in the growth of the blood vessels, from the walls of which the uterus and vagina originally receive their muscular tissue. Rosger, Kleinwachter, Sobotta and others have traced the development of early myomas from the vessel walls, and concluded that the blood vessels control the origin and growth of uterine myomas.

There are many who believe the origin of myomas is due to perivascular growths.

(b) Regarding the origin of adenomyomas opinions are at variance, and it is probable

that no single mode of origin can apply to all these tumors.

Origin has been suggested in: (1) müllerian body; (2) wolffian body.

Summarizing the evidence, one may conclude that simple myoma uteri arises chiefly from a disturbance in the development of the tubes, uterus, and vagina from Müller's ducts, which often leads at the same time to gross deformities and infantile characters in these organs.

Adenomyoma arises chiefly from the fetal or post-embryonal inclusion of müllerian epithelium in the tumor process. . . . The chief exciting factor is intermittent hyperemia connected with irregularities in the sexual functions.

In a recent paper by Nakuschkin (2), "The Etiology and Prophylaxis of Myomas of the Uterus," some very interesting data were obtained by an analysis of 688 cases of patients suffering from myoma of the uterus. He states that in myoma patients there is a great potential energy of the ovary in the form of increased follicular activity, with simultaneous absence of reproduction in the uterus. He says:

From this comes the natural conclusion that the uterine myoma is a pathological reaction to the ovarian impulse which replaces the normal, physiological reaction of pregnancy. . . . One comes in this fashion to the general pathogenetic assumption for uterine myomas: The myoma of the uterus is the menstrual product of sterile women with high reproductive potency.

This author finally concludes that fibroids are probably due to an excessive secretion of the follicular hormone.

It is a well known fact that fibroids have disappeared after double oöphorectomy, so that the etiology of fibroids may be due to a dysfunction of internal secretions.

Young and Williams, as quoted by Lockyer (3), give 10.5 per cent as the average sterility of women who have reached the age of 38, and Cullen observes that in women with fibroids 33 per cent are sterile.

The number of pregnancies in our series of cases is shown in Table I. It will be noted that only 9.2 per cent were sterile; of course, 15 per cent were single. The largest number of pregnancies was 16; 55.1 per cent (of 270 married women) had more than three pregnancies.

A diagnosis of myoma of the uterus may be made when the tumor mass in the uterus varies from the size of a hazel nut to the size of a seven- or eight-months pregnancy, is nodular and hard, and any of the following symptoms are present: excessive bleeding, at times associated with anemia; pressure symptoms which may cause frequency of urination or constipation; backache; gastro-intestinal disturbances, or even asthenia and neurosis in some cases.

Pain and tenderness are indicative of inflammatory disease of the adnexa or of degenerative processes in the myoma. It is important that the degenerative changes, such as atrophic, hyaline, cystic, fatty, calcareous, and necrobiotic, be kept in mind, and that in the cases of profound anemia, in which the loss of blood does not explain the low hemoglobin and total red count, some of the degenerative changes may lead to complications if they are irradiated. Calcification or symptoms of vascular disturbances, such as torsion, are also contra-indications to irradiation.

The importance of eliminating the possibility of a co-existing pregnancy must always be borne in mind. Early in pregnancy the Aschheim-Zondek (4) test may be of value. In the later months of pregnancy the fetus can be shown radiographically. Whenever there is doubt as to the possibility of an existing pregnancy it is better to wait a month, or several months if neces-

sary, rather than to irradiate a fetus. Murphy (5) has shown pretty conclusively that these children are injured, the majority of them being born microcephalic. On the other hand, a dose of roentgen ray or radium, making approximately 60 per cent of the erythema dose, may cause death of the fetus, and abortion.

The records of our tumor clinic show that about 16 per cent of all admissions in the gynecological department were myomas. Eleven of these cases showed a positive Wassermann reaction; three had a positive Neisser reaction. The negro race has a higher incidence of fibroids, but in our series only seven were colored women. Fibroid is exceedingly rare before the age of twenty. Table II shows the age incidence of fibroid in our series: 4.4 per cent were 30 years or younger; 66.4 per cent, 30 to 50 years of age; 29.2 per cent were outside the years of sexual activity, when the uterus is not capable of bearing. Our youngest patient was 22 and it will be noted that she was not treated; the oldest was 78 years of age.

Gauss and Lembcke (6) were among the pioneers in the treatment of fibroids and menorrhagia by means of irradiation. Their work consisted of roentgen treatment and their dosage and results were carefully worked out. It seems that the wave of enthusiasm has spread over the Continent of Europe and more recently to this country. There is no longer any doubt but that irradiation is of value and has its place in the treatment of fibromas. It remains for the workers in this field to publish their results from accurate observations as to the clinical findings, and the results that can be expected anatomically. Contributions on the subject of irradiation of myomas by Kelly (7), Burnham (8), Neill (9), Schmitz (10), Clark and Norris (11), Stacy (12), Wood (13), Donaldson (14) and many others have added to our knowledge of irradiation in this disease.

TREATMENT

Treatment, consisting of external radiation by high voltage roentgen ray at 80 cm. distance; filter 0.5 mm. copper, 1 mm. aluminum; size of field 20×20 cm.; two fields, one anterior and one posterior, was administered in two or four sittings on successive days. There was little, if any, disturbance, such as nausea, vomiting, or loss of time, from this method. The factors varied according to the thickness of the patient, an effort being made to put from 40 to 50 per cent in the ovaries and tumor mass. The same factors were used for "temporary sterilization" in which 28 to 35 per cent was administered to the tumor and the ovaries. This was particularly applied to patients below the age of 35, in whom an effort was made to control bleeding and to cause diminution in the size of the tumor, with the hope that menstruation would re-establish itself. In some instances radium packs were used at 6 cm. distance, field 6.5×7.5 cm., with filter of silver 0.5 mm., brass 2 mm., aluminum 1 mm., rubber 1 cm., using two or three fields through the lower abdominal wall. At this distance 17 per cent was administered at 10 cm. depth. Radium tubes were usually used in tandem, inserted in the body of the uterus, filtered through 0.5 mm. gold, 0.5 mm. brass, and 1 mm. rubber, varying, according to the size of the tumor and the distance of the tubes from the ovaries, from 600 to 800 mg.-hrs. of radium up to 1,600 milligram-hours.

In cases recorded here as having been treated by a combination of radium and external radiation, radium was inserted and allowed to remain for periods of from 1,200 mg.-hrs. to 1,600 mg.-hrs., and the total dose supplemented by 25 per cent of the skin dose in the ovary, administered by high voltage roentgen ray. These treatments were administered at the time of the curettage, which was precautionary, so that

malignancy of the fundus would not be overlooked.

RESULTS

Of these 318 patients, 34 were not treated, and 284 were treated as follows:

90 cases were treated by the insertion of

radium and high voltage roentgen ray.

90 cases were treated with radium tubes.

96 cases were treated by external irradiation (radium packs or high voltage roentgen rays).

8 cases were treated by myomectomy (submucous fibroids) and irradiation.

Eleven cases were lost track of immediately after treatment. Nine had no bleeding symptoms.

Of the 90 patients treated with radium and roentgen ray, 98.9 per cent stopped bleeding; however, one had a return of symptoms in two months and was subjected to hysterectomy elsewhere. This case might have shown better results if hysterectomy had been postponed for a few months. There was diminution in the size of the tumor in 71.4 per cent of these cases.

Of the 90 cases treated by the insertion of radium tubes, all, or 100 per cent, stopped bleeding. Diminution in the size of the tumor was noted in 89.8 per cent of these cases.

Of the 96 cases treated by external irradiation (radium packs or high voltage roentgen ray), 96.5 per cent stopped bleeding. One of these had a return of bleeding in one year and had to be subjected to further irradiation but has been well since. There was diminution in the size of the tumor in 75 per cent of these cases.

Considering the results of irradiation as a whole, in our series of cases, bleeding ceased in 98.5 per cent, in the majority of them at once. However, in five cases menstruation continued for from one year to one and a half years before cessation. Menstruation was re-established in 13 cases after "temporary sterilizing" doses. The follow-

ing are the results in these cases: Three of the patients were between the ages of 26 and 29—in all there was reduction in the size of the fibroid; menstruation was re-established immediately in one case; in six months in another, although she had to be given a full dose after two and a half years on account of the recurrence of profuse bleeding, and in the third normal menstruation was re-established in one year. Seven of the cases were between the ages of 30 and 35—in five of these the uterus returned to normal size, and normal menstruation was re-established in from six to eight months; in one, normal menstruation was re-established but the fibroid, which was very large, remained the same size; in another there were two periods three years after treatment. Three cases were 41 years of age—in one, normal menstruation was re-established after three months, then the periods became prolonged and the patient was subjected to further irradiation, too recent to permit of reporting the effects; menstruation became normal in the other two cases in one and one-half years; in one, the tumor was smaller; in the other the uterus remained only slightly larger than normal.

Diminution in the size of the tumor was noted in 85.4 per cent of all the cases, including all tumors.

It is true that the control of bleeding and regression of the tumor were most marked in those cases treated by intra-uterine radium application, but it is only fair to say that these tumors were, on the average, smaller than those submitted to a combination of radium and roentgen ray, or to external irradiation alone. Many of the largest tumors were subjected to external irradiation alone.

Of the 284 cases irradiated, surgery was resorted to in 11 on the advice of some other physician, because of the persistence of the tumor in six instances, and because of recurrence of bleeding in five cases—after

three months in one case, and in from three to three and a half years in four cases.

Menopausal symptoms—neurosis, hot flashes, sweating—do not seem to be any more severe after irradiation than in the average menopause, with a few exceptions.

In eight cases reported here, submucous myomas, which were present in cases with interstitial and subserous masses, were removed through the vagina, and radium then applied. These submucous growths varied from 6 cm. up to 15 cm. in diameter. Of these eight cases treated by myomectomy and irradiation, seven stopped bleeding within a month, one had two periods and then ceased. Three of the tumors were pedunculated and in two cases there were multiple myomas present also. These uteri returned to normal size.

It is the writer's belief that a closer association between the gynecologist, the radiologist, and the physicist will be conducive to a more accurate estimation of the value of irradiation in the treatment of myomatous tumors. One has only to follow the literature to see the great variations in technic in applying radium or roentgen ray in the treatment of this disease. It is not understood, apparently, that there is little, if any, difference in the control of myomatous lesions, whether by radium or roentgen rays; that the primary effect of irradiation is on the ovary, the secondary effect directly on the myomatous tissue.

A more careful selection of the cases for irradiation, especially with radium, should be encouraged, particularly when there is a suspicion of an associated malignancy in the fundus. It is essential that the physics of this agent be thoroughly understood. One finds that doses of radium, from 600 to 700 mg.-hrs., up to 2,400 mg.-hrs., are given by various operators for the control of this disease. It is easy for the casual observer who is not acquainted with the facts to do damage by leaving a single tube in a certain posi-

tion in the uterus for from 2,000 to 2,400 mg.-hrs., not keeping in mind that one author uses platinum of 1 mm. thickness, another uses lead of 2 mm. thickness with rubber immediately surrounding the tube. Greater accuracy in the description of the tubes, *i.e.*, length, amount of radium contained, thickness of the capsule, size of the tumor and so forth, all are problems which have to be taken into consideration.

It will be seen that many of the contraindications which are set up by the gynecologist can be overcome if these physical principles are kept in mind. For example, myomatous uteri, the size of a six- to eight-months pregnancy, without any degenerative inflammatory changes, can be, in selected cases, taken care of by external irradiation alone. I have seen such tumors atrophy so that the remnants of the growth were about the size of a three-months pregnant uterus. This type of case would not be suitable for intra-uterine application of radium. Even submucous fibroids can be so influenced by external irradiation alone that a good result is obtained. On the other hand, submucous fibroids presenting in the vagina or cervix would better be treated by removal of the fibroid, followed by the application of radium in the uterus, or external irradiation following the removal. Associated lesions, such as ovarian cysts, salpingitis, circulatory disturbances in the tumor, calcified tumors, or some of those showing marked degenerative process, would naturally best be treated surgically.

It is of importance, too, not to overlook associated malignancy. However, in our series only nine cases were observed associated with fibroid—five of fundus carcinoma, three of epithelioma of the cervix, and one of carcinoma of the ovary. In our entire series of 1,993 gynecological cases, as we have said, 318 were fibroids, while only 11 were malignant myomas. From these figures one can readily see that malig-

nant myoma is not a common disease, and that the tendency of myoma to become malignant is not great. All of our cases of malignant myoma were post-operative, and all but one, that was treated prophylactically, had recurred (15).

TABLE I.—SHOWING PREGNANCIES IN THIS

SERIES OF CASES	
No. pregnancies	No. incidences
Single	48
0	25
1	44
2	48
3	52
More than three	101
	318

TABLE II.—SHOWING THE AGE INCIDENCE AT THE TIME OF ADMISSION

Age	Not treated	Treated	Total
22-24	1	..	1
25-29	1	8	9
30-34	1	15	16
35-39	4	34	38
40-44	6	71	77
45-49	11	73	84
50-54	5	50	55
55-59	2	12	14
60-69	1	16	17
70-78	2	5	7
Total	34	284	318

CONCLUSIONS

1. Irradiation treatment in myoma of the uterus has a very definite place in gynecology.

2. The bleeding is controlled in from 96 to 100 per cent of the cases.

3. The size of the tumor is definitely influenced in 85 per cent of the cases treated, there being regression to normal or at least a diminution to 50 per cent of the original size.

4. Of the cases reported, 98.5 per cent were symptomatically well. The menopausal symptoms—neurosis, hot flashes,

sweating—do not seem to be any more severe after irradiation than in the average menopause, with a few exceptions.

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CONDITIONS WHICH RESULT IN COLLAPSE OF THE LUNG¹

By R. P. POTTER, M.D., Marshfield Clinic, MARSHFIELD, WISCONSIN

SOME of the conditions under which an entire lung, a lobe of a lung, or a part of a lobe is found to be airless are (1) atelectasis of the newborn, (2) plug-

ly plugged by a foreign body or a tumor of a bronchus the alveolar air in the lung is quickly absorbed by the circulation and the lung is in a state of collapse against the



Fig. 1-A. Case 1. Post-operative massive collapse of right lower lobe following left inguinal herniotomy under novocain.



Fig. 1-B. Case 1. Film made two hours after turning patient on left side. Right lung is completely re-inflated.

ging of a bronchus by a foreign body or a tumor of a bronchus, (3) pleural effusion, hemothorax, pneumothorax, intrathoracic tumor, or (4) idiopathic massive collapse.

(1) Roentgenologic studies of the chest of the newborn shortly after birth frequently show small areas of lung which have not yet become inflated. These atelectatic areas usually become fully expanded within a few days.

(2) When a bronchus becomes complete-

ly plugged, the heart and trachea displaced toward the affected side, and the diaphragm elevated.

(3) Pleural effusion, hemothorax, pneumothorax, and intrathoracic tumors cause a certain amount of collapse of lung due to pressure and may also cause displacement of mediastinal contents, but when there is displacement it is toward the uninvolved side.

(4) Idiopathic massive collapse is a condition in which a previously normally aerated lung suddenly becomes airless without any apparent cause.

¹Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1-5, 1919

nant myoma is not a common disease, and that the tendency of myoma to become malignant is not great. All of our cases of malignant myoma were post-operative, and all but one, that was treated prophylactically, had recurred (15).

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Fig. 4-A. Case 3. May 21, 1929, left lung again partially collapsed.



Fig. 4-B. Case 3. June 14, 1929, collapse nearly complete.



Fig. 5-A. Case 3. June 25, 1929, upper portion partially expanded again, following bronchoscopy on June 19.



Fig. 5-B. Case 3. July 13, 1929, left lung again fully inflated, heart and trachea in normal positions.

Neither its etiology nor mechanism has yet been explained to our entire satisfaction. In 1890 W. Pasteur (2), an English physician, first introduced the term "massive collapse" into medical literature, and in 1908 reported finding collapse of lungs at autopsy

on children who had died of diphtheria and who had had paralysis of the diaphragm. He considered this paralysis a causative factor of collapse. We know that phrenicotomy causes paralysis of the diaphragm but does not cause collapse of the lung.



Fig. 2-A. Case 2 Post-operative massive collapse of right lung following appendectomy (gangrenous appendix), under ether anesthesia.

Fig. 2-B. Case 2. Film made twenty-four hours after turning patient on left side. Heart and trachea in normal positions and lung nearly completely reinflated.

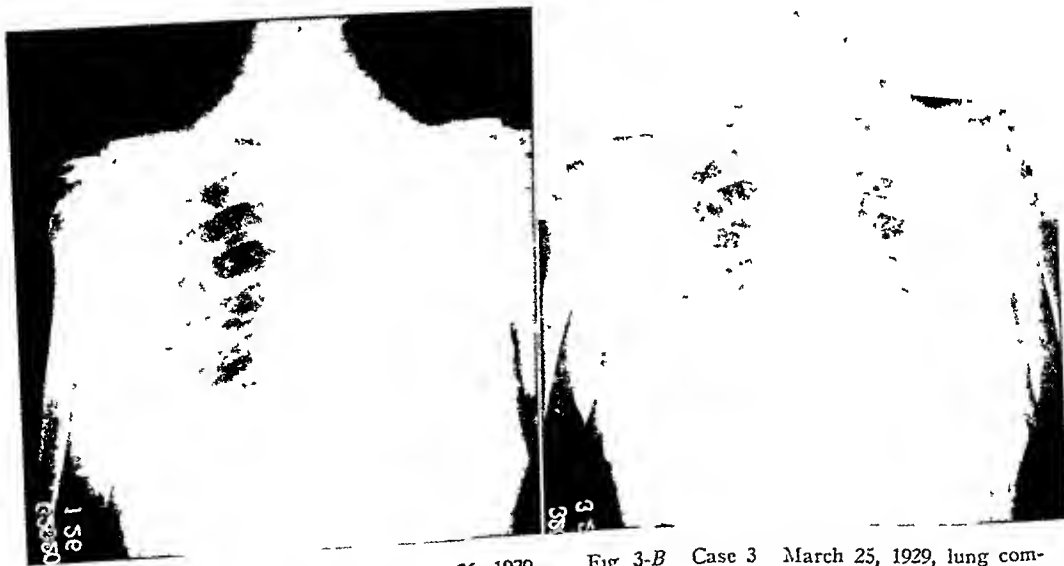


Fig 3-A Case 3 Mrs B R, Jan 26, 1929, left lung collapsed, heart and trachea displaced to the left, carcinoma of left bronchus.

Fig 3-B Case 3 March 25, 1929, lung completely reinflated following bronchoscopic examination

I will confine my discussion to massive collapse, collapse due to tumor of a bronchus, and collapse in pneumothorax.

Massive collapse has been defined by John Rose Bradford (1) as "an unusual condi-

tion in which the lung, without the presence of any gross lesion, such as bronchial obstruction, pleural effusion, etc., interfering with the free entry of air, becomes airless to a greater or less degree."

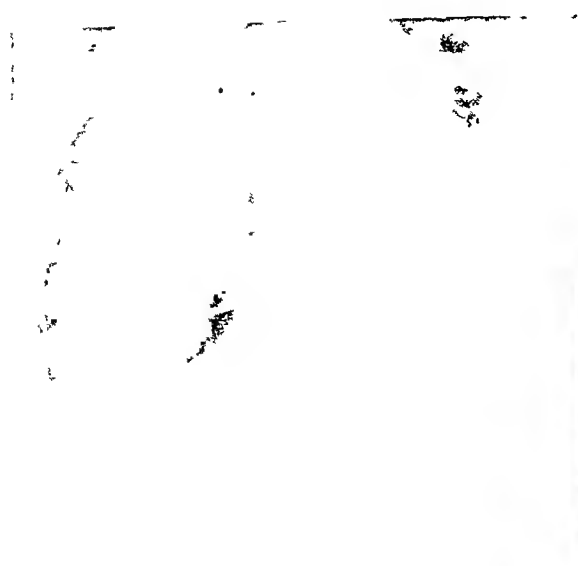


Fig. 6-A. Case 4 Right hydropneumothorax, July 6, 1922



Fig. 6-B Case 4. Pneumothorax as it appeared during period from 1922 to 1929

If postural treatment does not reinflate the lung, bronchoscopy is indicated. Sante (4) has suggested that all surgical patients should be turned from side to side every few hours for the first few days following operation as a prophylactic against the occurrence of massive collapse, and he also suggests that drugs having a tendency to concentrate the bronchial secretion and inhibit the cough reflex, such as atropin and morphin, be used as sparingly as possible in the pre-operative treatment of surgical patients.

CASE REPORTS

Case 1. A. S., male, aged 35 years, was admitted October 18, 1928. The following day an operation for left inguinal hernia was done under novocain anesthesia. On the third day post-operative there was a collapse of the right lung, with the symptoms of pain, increased respiration, cough, and a sharp rise in temperature. The patient was turned on his left side and a film, made two hours later, shows the right lung to be fully expanded. The patient was discharged November 4, 1928, fully recovered.

Case 2. H. M., aged 16 years, was admitted April 19, 1929, and the following day an operation was done for gangrenous appendicitis, under ether anesthesia. A bedside film, made on April 22, showed the right lung to be collapsed. The patient was rotated, and on the following day a second bedside film showed the lung to be normally expanded following the postural change. The patient was discharged on May 1, 1929.

Collapse of lung due to tumor of a bronchus cannot be differentiated from idiopathic massive collapse except by bronchoscopic examination. The appearance on a roentgenogram is the same in both conditions, the affected side being dense in appearance, the heart and trachea displaced toward it. The lung which is collapsed but not separated from the chest wall is of the same density as the heart shadow because of the engorgement of the blood and lymph vessels. The diaphragm is elevated and the chest smaller on the side involved.

The following case of carcinoma of a bronchus was of considerable interest because we were able to study the case during

Many cases have been reported in recent years and many theories advanced as to the probable cause or causes of its occurrence. Scott and Joelson (3) have advanced the opinion that posture may be a factor, and

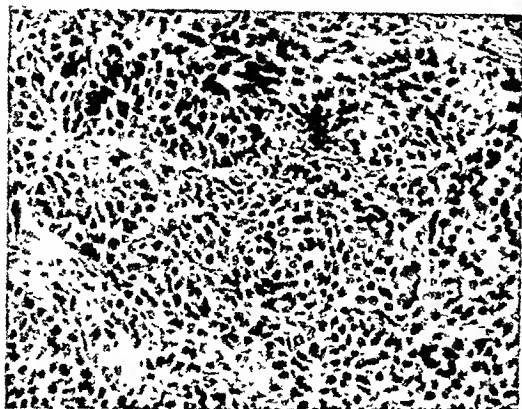


Fig. 5-C. Case 3. Photomicrograph of tumor of bronchus. Highly differentiated cells supported by a minimal stroma indicating a highly malignant growth.

cite the case of a patient with bilateral kidney stones who was twice operated on, each operation being followed by collapse of the opposite lung. Sante (4) says:

It seems most logical to suppose from the available evidence that massive atelectatic collapse of the lung results from a simultaneous inhibition of the cough reflex by some toxic or reflex stimulus in association with an impairment of the respiratory function, either immobilization of the respiratory muscle from a defence reaction or paralysis from toxic neuritis. This in turn permits the accumulation of secretions, blocking the bronchi, which results in atelectasis. Posture favors the development in the most dependent portion. Occurring alone, any one of these factors alone may not be sufficient to produce the condition; their simultaneous occurrence, however, may be all that is necessary to result in collapse.

The two cases I wish to report occurred in entirely different conditions throughout

except that in both the right lung was involved. One was a young adult, the other twice his age; one in April, one in October; one an inflammatory condition, the other a clean case; one an appendectomy, the other a hernia; one under ether, the other novocain; one operation on the right side (appendectomy), the other on the left side (left inguinal herniotomy). Massive collapse occurs as a post-operative complication and following injuries, and may closely simulate pneumonia. Pneumonia is a frequent post-operative complication and for this reason massive collapse may be overlooked. Collapse may follow any operation or injury or the use of any kind of an anesthetic—be it local, spinal, or general.

The condition usually develops during the first few days following operation; the patient complains of sharp pain in the chest, there is increased and embarrassed respiration, cough, and a rise in temperature.

On examination, the apex of the heart will be found to be displaced toward the affected side. All cases of post-operative pulmonary complication should have a roentgenologic examination if possible, and if collapse is present the involved area will show a density equal to the heart shadow or a dense pneumonic consolidation, the diaphragm will be elevated, while the heart and trachea will be displaced toward the side involved.

The treatment is, first, postural, the patient being turned on his side with the involved lung uppermost, and he is induced to cough. This treatment will usually cause the lung to reinflate and the symptoms to subside. If the case is of short duration, the lung clears very rapidly, but in cases that have existed several days there may be some delay, due to an accumulation of mucus, which is Nature's method of producing cough and, finally, recovery. These cases may have an abundant mucous expectoration.

but bleeds easily. A small piece of tissue was removed through the bronchoscope for examination. Dr. C. H. Bunting, of the Department of Pathology, University of Wisconsin, examined this and reported primary carcinoma of bronchus.

A roentgenogram of the chest on March 25 showed the left lung to be fully expanded, the heart and trachea in normal position. On May 21, 1929, a roentgenogram showed the left lung again partially collapsed, and on June 14 another film showed it to be almost entirely collapsed. Another bronchoscopic examination was done on June 19, and a needle containing twelve and one-half milligrams of radium element was implanted in the mass in the left bronchus and allowed to remain for four hours. On June 25, a roentgenogram showed the lung partially reinflated and on June 29 the lung was fully expanded. On July 10, another bronchoscopic examination was made and at that time papillomatous masses were found in both main stem bronchus. A twelve and one-half milligram needle of radium element was implanted in each and allowed to remain for four hours. Roentgenograms were made on July 13 and 20, and the left lung was found to be completely inflated, the heart and trachea being in their normal positions. The patient was discharged to her home on July 29, where she remained until her death on January 30, 1930.

Pneumothorax occurs with collapse of lung to a greater or less extent, according to the conditions present governing the equalization of air pressure. The amount of pneumothorax present in puncture wounds of the thorax depends on the size of the opening as compared to the size of the bronchus (5). Spontaneous pneumothorax with collapse of lung resulting may be caused by rupture of emphysematous blebs on the surface of the lung (6). These patients usually recover rapidly, with absorp-

tion of the air in a few days. Sante (8) records one case in which the air was completely absorbed and the lung fully inflated in two days, while in another case four weeks were required. In the case of spontaneous pneumothorax that I am reporting at this time, eight years have elapsed and recovery is not yet complete.

Case 4. This patient, Mr. A. B. C., railroad conductor, aged 40 years, was first examined July 6, 1922. He stated that during the previous four years he had been troubled with what he called bronchial asthma, that he felt weak as compared to his former strength, that he was troubled with a cough, and became short of breath on exertion. On examination a large pneumothorax was found on the right side and a roentgenoscopic examination showed a very small amount of fluid in the right pleural cavity. The heart and trachea were not displaced and there was no evidence of any part of the right lung. Frequent roentgenologic examinations were made from 1922 to 1928, and there was never any evidence found of the right lung, never any displacement of heart or trachea, and never any evidence of pleural effusion after the first examination, until an examination of the man in May, 1929, revealed the lower lobe of the right lung to be partially inflated, proving that the right lung had been present, but in a state of collapse. Another examination one year later, in May, 1930, showed the same amount of expansion of the lower lobe as one year previously.

This case demonstrates that a completely collapsed lung may occupy a very small space, provided the pleural surfaces are separated, permitting the retraction of the lung toward the midline.

CONCLUSIONS

1. Because of the fact that the symptoms of post-operative massive collapse and post-operative pneumonia are so similar, an



Fig. 7-A. Case 4. May 28, 1929, right lower lobe partially expanded after lung had been deflated for seven years.



Fig. 7-B. Case 4. May 3, 1930, no change in the past year.

several attacks of collapse, followed each time by reinflation.

Case 3. The patient, Mrs. B. R., aged 66 years, was admitted to the hospital on January 25, 1929, complaining of persistent vomiting after meals. This condition had begun in August, 1928, and had continued to the time of her admittance. She gave a history of having had pneumonia in February, 1928, with a fairly good recovery, after which she had been well until August, when vomiting began, and she also experienced complete loss of voice. The vomiting persisted but the condition of her voice improved so that she was able to talk well at the time of admission. Her weight on admission was 86 pounds.

Some time previous to her admission to our hospital a clinical diagnosis of carcinoma of the left bronchus had been made by Dr. Joseph L. Miller, Clinical Professor of Medicine, University of Chicago

on admission revealed complete collapse of the left lung, the trachea and heart being markedly displaced to the left. On account of the persistent vomiting a roentgenologic study of the gastro-intestinal tract with a barium meal was done, but nothing of pathologic significance was found. Following the ingestion of the barium, however, the vomiting, which had persisted for five months, ceased, and the patient showed some improvement in her general condition.

On February 1, 1929, a bronchoscopic examination was done by Dr. L. A. Copps, a member of our group, and the following findings noted: Left abductor of vocal cord paralyzed, lower third of trachea is displaced sharply backward to the left, trachea and bronchi rotated so that a line bisecting main bronchi is at an angle of 60 degrees to the transverse plane and the two main bronchi at first are almost parallel. The left main bronchus is filled with a mulberry-like or cauliflower-like mass, which is not ulcerated

Roentgenologic examination of the chest

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DR. K. D. A. ALLEN (Denver, Colo.): I believe it is appropriate to mention three cases that came to my attention a month or two before this meeting. They should, perhaps, be called "traumatic pneumothorax." Two were due to automobile accidents in which ribs were fractured, with one-sided pneumothorax; the third occurred during a *right* kidney operation and involved the *left* side of the chest. All three of these cases had subcutaneous emphysemas in the neck and both sides of the chest. In one of them, the emphysema reached clear to the legs. In the operative case, the pneumothorax extended to the opposite pleural cavity. I am a little curious to learn the route

which that air followed, from the pleural cavity of one side to the opposite side, in one case, and from the pleural cavity of one side to a symmetrical subcutaneous emphysema in the other cases. It has occurred to me that it went to the mediastinum and from there through the deep tissues to the neck. I would like to hear some discussion on that point.

The essayist's plates showed a point in relation to atelectasis which I believe is worth mentioning. One of his cases showed a collapse, by pneumothorax, of the lower right lobe and yet marked translucence was still remaining. A large amount of air remained in that lung. The atelectatic lobe collapsed no more than the pneumothorax-collapsed lobe—it was very dense and not translucent at all. The only difference existing between these two collapsed lobes was that the one still had access to the outside atmosphere while the atelectatic lobe did not. I believe that point in those two situations shows that, regardless of the cause of the collapse, the cause of the density is blockage of a bronchus, preventing access of the portion of the lung served by that bronchus to the outside atmosphere.

DR. POTTER (closing): One point I wish to emphasize is that we should be guarded in our prognosis in cases of so-called idiopathic pneumothorax. Idiopathic pneumothorax may exist for years, as may be seen in the case I have shown. This man's right lung remained completely collapsed for several years and now, after eight years, is only partially inflated and he is still unable to attend his usual duties as a railway conductor.

X-ray examination should be made in all surgical cases having pulmonary complications.

2. A skilled bronchoscopist is not always available, and as most of these cases of post-operative collapse will be relieved by posture this method should be used early.

3. A lung may be completely collapsed, either by plugging of a bronchus or in association with pneumothorax, for long periods of time without apparent impairment of function when reinflated.

4. On account of the long time that a lung may remain collapsed and again begin to function, we must be guarded in our prognosis, especially in cases of pneumothorax, which usually clear up rather quickly but may remain collapsed for years.

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DISCUSSION

DR. ROY A. PAYNE (Portland, Oregon): In regard to the use of carbon dioxide gas, not only as a treatment for the condition of massive collapse but also as a preventative measure, this is being used a great deal by surgeons in Portland at the present time.

There is another point in regard to spontaneous pneumothorax which might well be brought out. The slides shown are the last two cases of spontaneous pneumothorax that have come under our attention. The first is

one of a girl who started out with a low-grade pneumonic process in the right lower lobe of the lung. She progressed splendidly, but with a sudden onset of cyanosis experienced difficulty in breathing and there was evidence of the total collapse of the left lobe. There were these adhesions [indicating on slide] showing on the left upper portion which prevented the total collapse. This patient came from a tuberculous family: her older brother had died the year before, apparently having no symptoms and suddenly coming down with miliary tuberculosis and fading out of the picture in a short time. This patient's lung never recovered, and death ensued. We have another case with partial collapse of the left lung that was examined by an associate, and in it again we have diffuse infiltration throughout the lung tissues.

In a moderate number of cases under observation, so frequent has been the association of a low-grade tuberculosis with this spontaneous pneumothorax that I believe every effort should be made to exclude tuberculosis before it is dismissed as not being an etiologic factor. It is not enough to say simply that tuberculosis is not present, because I believe if the cases are studied we will frequently find that those persons who have suffered from spontaneous pneumothorax have a family history of lack of resistance to the germ of tuberculosis, and that this lack of resistance probably renders them more subject to the action of spontaneous pneumothorax.

DR. L. T. LEWALD (New York): I wish to make a plea for a little care in the use of the names given to these conditions. It seems that the word "atelectasis" has now come to represent the type of lesion associated with the plugging of a bronchus such as may follow some operative procedure, while the other type of lesion in which the lung is forcibly collapsed from air entering the pleural cavity is commonly spoken of as "pneumothorax." If one uses the term "collapse" to cover both these conditions, it is confusing, and I hope that we may all make these distinctions. Furthermore, I think the third distinction as to the type of pneumothorax, which

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THE PATHOLOGIC CERVIX: A PRECANCEROUS LESION¹

By B. H. ORNDOFF, M.D., F.A.C.R., CHICAGO, ILLINOIS

FOR the purpose of this paper, I wish to refer to the diseased cervix uteri as the pathologic cervix, and to include all of the conditions affecting its tissues, other than cancer.

A precancerous lesion is a condition of the tissues in which they have suffered insult from irritation, which may affect growth control to such an extent that hyperplasia and malignant tendencies may follow. The term "precancerous" has called forth drastic criticism, but nothing has yet been offered which will better designate the condition which occupies such an important position in pathology and clinical medicine.

Clinicians throughout the world, in discussing the causative factors in cancer, refer to the conditions in tissues which constitute precancerous changes as of very great importance, and their recognition and relief seem equally as important as the cure of a definite cancer. We may quote from Bloodgood, "Cancer never begins as cancer," and from Quigley, "The physician who would serve his patient well in this field must recognize not only early cancer, but he must be able to determine precancerous conditions."

The cells composing any tissue must maintain a definite rate of growth, or reproduction, in order to remain healthy and normal. These cells also perform other functions which characterize their particular tissue. It is when the various functions of the cells are interfered with that the dominant function of growth, or reproduction, stands out pre-eminently, and if the factor of interference is not too great, cell division will continue, other functions being lost, and the tissue thereby will approach the state we

designate as cancer. Obviously the development of this situation in a tissue carries the element of time, since the functional interference must continue through the period of the existence of many succeeding cell groups before the new cells are forced to give up their less fundamental functions and to place in reproduction all of their available power, in the attempt to save the existence of their tissue. It is these tissue changes, with their associated functional phenomena, together with the agent of irritation and the lapse of time that constitute a precancerous lesion.

A study of the etiology and the nature of precancerous lesions always involves a consideration of the diagnosis of early cancer. The site where a cancer begins is always subjected to some kind of irritation, usually chronic in character, before malignancy is established. The cervix uteri is the most frequent site for cancer in woman. Its tissues are probably always subjected to an irritation, attended with disturbance of cell function and cell destruction, before positive cancerous changes can be detected in the cells.

Anatomically, the cervix usually suffers important changes while in the performance of its natural functions: it is indeed the exception, not the rule, to find an undamaged cervix in the parous woman. Damage to the cervix during birth is more frequent and more serious as a rule than the injuries sustained by any of the other structures or organs along the birth canal.

In the cervix, as in many other organs, functional equilibrium is lost whenever there is structural disarrangement. The fact that in the cervical canal, columnar epithelium is laid down on the fibro-muscular composition of the cervix without the support and pro-

¹Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, December 1-5, 1930.

tection of a well-defined basement membrane is one of the factors predisposing this canal to chronic pathologic processes. The cervical canal receives the products of glandular secretion, the structures of which are distributed between the bundles of smooth muscles far beneath the columnar epithelial lining of the canal. It is obvious that very slight structural damage will alter function between the external and the internal os uteri, creating the presence of abnormal endocervical secretions. The presence of normal vaginal bacterial flora, with this, their acid reaction, together with the chemical irritation from disintegrating cellular debris collecting here from corpus uteri during menstruation, are important factors in building within the cervical canal a chronic pathologic lesion.

The vascular and lymphatic arrangements in the anatomy of the cervix are such as will promote quick absorption into the region of the broad ligaments and pelvis, and thereby constitute another important factor for consideration.

Cervicitis is almost always a lesion affecting the vaginal portion of the cervix. The stratified epithelium covering the pars vaginalis is damaged or lost, and the subepithelial structures show vascular injection and other reactions of irritation. This lesion usually indicates an ulcerating lesion in the canal and a pathologic discharge from the cervix into the vagina.

Ectropion and erosions also constitute pathologic lesions within the scope of this paper.

Diagnosis of a pathologic cervix is usually very simple.

Palpation of the cervix and its associated pelvic viscera on a table equipped with an X-ray fluorescent screen, so that visible densities and mobilities may be determined along with palpation, constitutes a very important part in diagnosis. *Inspection* of the cervix, aided by efficient illuminating apparatus, a properly selected speculum which

may be adapted to the vaginal cavity in such a manner that the cervix is properly exposed and illuminated, a graduated flexible probe, uterine dressing forceps, cotton, etc., form another link in the diagnostic chain. Diagnosis of pathology within the cervical canal requires inspection of *trachelograms*. The technic of producing the trachelograms is important, and it is probably most desirable to fill the cervix with the opaque substance over the fluorescent screen, and, when proper angles are observed, expose the films for the trachelograms at that time.

TREATMENT

Treatment of a pathologic cervix is important. Assuming that pathologic cervixes precede the development of almost all malignant cervixes, it becomes necessary that a plan be adopted to secure a positive result, and that the time interval be not too long.

Surgical amputation and surgical repair of the cervix by the older methods have come to be very seldom the methods of choice, since by electrocoagulation and the use of other electrosurgical procedures the end-results are satisfactory and the liability of complication seems almost *nil*. By electrocoagulation all of the diseased tissue can be destroyed, and when a granulation base has been formed, the coagulated tissue becomes separated, leaving a healthy, resistant base upon which a normal mucosa regenerates.

The technic of coagulation is a procedure requiring a working knowledge of the equipment adapted especially for this field, together with sufficient surgical training to enable the operator to enter the operating room with confidence that he will be able to cope with the unusual phases of surgical pathology always encountered in a long series of cases.

SUMMARY

Summarizing the facts which I have endeavored to present, and adding a few more,

the detailed discussion of which my limited time would not permit, I wish to set forth the following statements in a somewhat aphoristic fashion:

1. The importance of a precancerous lesion has been emphasized.

2. Chronic irritation may interfere with cell functions.

3. Irritated tissues may lose all of their functions, except the more fundamental power of reproduction and growth.

4. Attention has been directed to the importance of a pathologic cervix.

5. Subjective symptoms of a pathologic cervix are frequently only a leukorrhea, and the patient must be informed in a manner to inspire confidence, in order that a delay, with disastrous consequences, may be avoided.

6. A pathologic cervix is usually a focus of infection.

7. A pathologic cervix is probably the most frequent example of a precancerous lesion.

8. The anatomy of the cervix uteri is of such a character that very little resistance can be offered to the spread of cancer when cell growth has begun to invade other tissues.

9. Statistics show that cases of cancer of the cervix constitute about one-third of all cases of cancer.

10. Statistics also indicate that more than 70 per cent of parous and 25 per cent of nulliparous women have a pathologic cervix.

11. It is the great frequency of irritation of the cervix that accounts for the very high incidence of cancer.

12. Cancer of the cervix is not known to develop in an otherwise normal cervix.

13. Between fourteen and sixteen thousand women, ranging in age from 30 to 50 years, die annually in the United States from this form of cancer.

14. Elimination of the pathologic cervix

would prevent almost entirely this great loss of life.

15. The value of a periodic pelvic examination for women between 30 and 50 years of age, to be conducted by physicians trained and equipped for this special class of work, can hardly be overestimated.

DISCUSSION

DR. HENRY SCHMITZ (Chicago): The presentation of the subject of the pathologic cervix as a precancerous lesion is a timely one, and Dr. Orndoff deserves our deep appreciation for the scientific investigation made and the method of treatment involved. It is by such investigations that cancer may be headed off, and if similar tactics were applied in other regions of the body the control of cancer would be assured. A pathologic cervix should always be treated, whether it causes or does not cause symptoms. Quite a group of these cases results from a disturbed biology and physiology of the parts seen, especially in the non-deflorated patients. Another group of cases is the result of infection, especially the gonorrheal. This group is the largest in number and the most important. A third group is formed by the traumatized cervix, whereby the cervical canal mucosa is exposed to the irritation of the vaginal secretion and the irritation of the sexual function. In this latter instance, the trauma seems merely an easier access to the same two causes given in Groups 1 and 2.

The question arises as to how we may detect these lesions. Obviously, periodic health examinations are the only means. Such examinations should include a painstaking examination of the cervix and other genital organs. If, on examination, erosions, ulcerations, or nodules are found, then the simple touching with a cotton-covered probe or a superficial incision of the nodule with a scalpel will aid us in differentiating the benign from the malignant lesions. Probably 80 per cent of these lesions are perfectly benign; it is only in the other 20 per cent that we seek the precancerous or cancerous lesion. Free arterial bleeding, continued for some time, is usually a sign of the malignant nature of the lesion. Absence of

active bleeding usually means benignancy. If the former is found, then a biopsy should be done. Immediate frozen section examination will rule out—or in—carcinoma. Benign lesions should be treated by cauterization; there is no other method of treatment so successful. Douching and local medication should be consigned to the scrap heap. They are no longer considered as recognized therapeutic measures for these lesions. The cautery blade or loop must destroy all pathologic tissue to assure complete healing afterwards. Should biopsy show malignancy, then radiation therapy is indicated.

As I stated before, Dr. Orndoff deserves our gratitude for the presentation of this important and timely subject.

DR. GEORGE A. WYETH (New York City): When we realize that one woman in every eight develops cancer and, of these, one out of three develops it in the uterus, and that nine out of ten cancers of the uterus are cervical, we can begin to realize the importance of the work brought out so strikingly by Dr. Orndoff to-day. There are two points in his paper upon which I should like to touch—the etiology and the treatment. However, Dr. Schmitz has gone so deeply into the etiology and covered it so completely that I wish only to emphasize certain points. He says that the site where a cancer begins is always subjected to some kind of irritation, usually chronic in character, before malignancy develops. This, I feel, is now a clinical fact. We have sufficient evidence to bear out this statement. I would call your attention to the conclusions of Dr. Bailey, in his classical work on carcinoma of the cervix and erosion.

More recent research points to the fact that cancer is now to be considered as a process. Thus, Cramer, of the Imperial Cancer Research Laboratories, reports a series of experiments which may prove to be of the highest importance. Cramer has shown that if a large area of the skin of a mouse is subjected to chronic irritation by tar-painting, the development of malignant growth is confined to a very small portion of that area. If papillomas have developed in the area, together with the malignant growth, they retain their benign

character. If, after the removal of the malignant growth, the area of skin in which no malignant development has taken place is preserved, it is found that in that area malignant growth may develop again in a new center, either beginning at the base of a papilloma which may have been left behind or starting as an entirely new growth. Removal of the second malignant tumor has sometimes been followed by the development of a third malignant growth. In further experiments in which irritation was applied directly to the base of a papilloma, immediate malignant development was observed in six adults. Cramer concludes that these observations supply evidence that the development of a carcinoma is not entirely dependent upon changes in the epithelial cells, but that there are local inhibitory factors capable of keeping the malignant development in check, and that the immediate cause of the genesis of a carcinoma may be the removal of a local inhibition residing in tissue elements other than epithelial cells. The process of carcinogenesis is, therefore, not a continuous one, but is composed of two phases: a process of long duration which induces a state of "potential malignancy" kept in check by a local resistance, and, secondly, a local breaking down of this resistance, which allows of an immediate malignant development of the "potentially malignant" cells.

It seems to me that this is analogous to the work Dr. Orndoff has brought out to-day and does apply along just the same lines of reasoning as he has developed here in the etiology of his cervical cancer.

Treatment.—I want to emphasize what Dr. Orndoff has said about coagulation. You know I am really more enthusiastic about coagulation than he is and it pleases me greatly to meet with his experience, and to hear him make such striking, sparkling statements as he has made to-day about electric coagulation being the method of choice in the treatment of these cervical precancerous lesions. It seems to me that if he can do four hundred cases and show that in the cases he has treated malignancy has not developed in one, it is a method of which we must take cognizance.

I would mention that there are two ways of

inducing the same effect in this precancerous condition, namely, by coagulation, as he has advocated; and then I must mention the work of Mortimer Hyams, of New York, who has devised an instrument to apply the cutting current. It is an electrode with a wire bent at right-angles to the straight line of the instrument which he puts up into the cervix, and, turning it, he reams out the interior of the cervix with the cutting current. He seems to think that this is a superior way of doing it. Be that as it may, I was in communication with him just before I left New York and he told me that he has now adopted this procedure in over three hundred cases and has not seen malignancy develop in one of them. If this is so, and we can prevent cancer by *cleaning up these cervixes, it seems to me that it behooves us to do it.*

DR. H. J. ULLMANN (Santa Barbara, California): There is one point mentioned by Dr. Orndoff and Dr. Schmitz which I wish to emphasize—the biopsy. If one keeps a Gaylor specimen forceps on the tray in the office with the speculum, one can often take a small specimen the size of a split pea from the cervix during the examination of the patient, frequently without the patient knowing that it has been done. Once in a while a tender cervix is found, but this is relatively infrequent. When a biopsy is taken, be sure to get specimens from more than one place. I have received a report of chronic cervicitis from one specimen and carcinoma from another. To again emphasize the necessity for biopsies, I will cite the case of a patient who clinically

showed chronic cervicitis, but the report was definitely malignant. Within the last few months I have examined a patient with a clinical carcinoma of the cervix in gross appearance, yet the report from three separate specimens from three different places on the cervix was chronic cervicitis only. Do not forget that radium is being used very successfully in certain cases in the treatment of endocervicitis.

DR. HENRY SCHMITZ: Dr. Ullmann has asked why I do not recommend the use of radium in chronic cervicitis. I believe that the method which is the safest and curatively best should be the method to use. I feel that the application of radium in chronic cervicitis has an element of danger in it. May I cite a few cases that come to my mind now? I recall a young woman who came to us three or four years ago on account of amenorrhea following the application of radium for chronic cervicitis. In spite of a stenosis of the cervix, she conceived. Although the patient was given the test of labor, a cesarean section had to be done on account of the unyielding fibrotic cervix. I have several other patients under my care who have had chronic cervicitis and have been treated with radium with the result that they menstruate once or twice a year and are sterile. I do not wish to say that the radium was applied incorrectly or in large doses. When one sees a great number of cases of this kind one should pause and hesitate to use radium. On the other hand, the cautery method, described by Orndoff, is safe and heals the cervicitis in the majority of cases.

CHEMICAL EFFECTS OF X-RAYS UPON SOME AROMATIC COLORS AND DYES

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THE chief difficulty in measuring X-ray quanta or intensities by chemical methods lies in the fact that the total changes effected by this radiation during a reasonable time interval are too small to readily lend themselves to ordinary analytical procedure. In fact, the minuteness of the changes involved, together with the necessary accuracy needed, precludes ordinary chemical methods from all practical considerations by any but expert analytical chemists. Here exists the chief difficulty in the practical application of Eder's solution (1, 2) or any other similar chemical method to dosage measurements. Yet, the need for some accurate, simple, and convenient method for periodically checking the performance of X-ray tubes and dosimeters still exists.

Many organic compounds change color while exposed to X-rays. The presence or absence of color furnishes some of the most accurate indications known of the progress of many chemical reactions. Of course, many organic reactions occur without color changes, but it frequently becomes impossible to detect non-visible chemical changes of very small magnitude by any simple method. Furthermore, several organic dyes, colors, and structurally related compounds are given internally to patients to increase the visibility of certain body parts on an X-ray film.

Due to the growing importance of this field, articles have appeared from time to time in the literature. H. Bordier (3) studied the action of X-rays on iodine and on starch iodide in aqueous media and found that the results obtained after many hours by ultra-violet light were produced by X-rays

in a few minutes. Glocker (4) investigated the action of X-rays upon iodoform in chloroform and other solvents and observed that the liberation of iodine was some function of the solvent used and probably due to a secondary reaction. Gunther and his co-workers concluded that HCl and HI were first formed when chloroform and iodoform were exposed to the action of X-rays. Ferman (6) first, and later Reinhard and Tucker (7), noticed a slight inversion of sucrose both in the crystalline and dissolved condition upon long exposure to X-rays. Also, many studies concerning the effect of X-rays on complicated substances present in the body have appeared.

Clark, Pickett, and Johnson (8) examined the effect of X-rays upon the anthracene-di anthracene equilibrium, iodine and benzene, the inversion of sugar in the presence of lead nitrate and alpha-acetoxy mercuri-B-methoxy hydrocinnamic ethyl ether. The iodine-benzene sample had less free iodine left after exposure. Free mercury was liberated from the mercury compound.

Of particular interest in this field is the work of Stenstrom and Lohmann (9) in testing a number of colors with X-rays, namely, methylene blue, gentian violet, acid fuchsin, mercurochrome, erythrosin, and eosin. Methylene blue showed the most pronounced color change and the authors suggest its use for dosage measurements.

However, the vast number of organic compounds and their structural complexity make it difficult to correlate experimental data unless they are taken under comparable conditions. Therefore, in this work, quite a few of the general structural types of aromatic colors are tested under the same conditions of exposure to X-rays, to find

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out which kinds are most susceptible to color change. One can suppose that any structural shifts in a complicated molecule will probably start at the bonds which have the greatest lability toward X-rays. By starting with simpler structures with a known reactive group it may be possible to gain some insight into the mechanism of some of the reactions with more complicated compounds.

The color changes were obtained by exposure to X-rays under conditions much less drastic than medical use necessitates. The X-ray apparatus consisted of a Coolidge type tungsten target tube. The samples were placed in two-inch evaporating dishes and exposed for 10 minutes at 50 kilovolts and 1.4 milliamperes except in a few special runs. This was deemed sufficient for

standard qualitative test purposes. The X-rays also passed through approximately 15 cm. of air from the outside glass surface of the tube to the upper surface of the solution in the evaporating dish. In every case a non-irradiated control sample was compared with the irradiated solution in glass tubes of the same diameter against a white background. In almost all cases the colors were dissolved at room temperature in freshly boiled distilled water which eliminated any differential effects due to varying amounts of dissolved oxygen.

EXPERIMENTAL RESULTS

The following experiments were made under the standard conditions:

Substance	Color before irradiation	Color after irradiation
1. Phenol + H ₂ O + FeCl ₃	Dull lavender	Slightly paler
2. Phenol + H ₂ O + CoCl ₂	Pale pink	No change
3. Phenol + H ₂ O + CuCl ₂	Pale blue	No change
4. Phenol + FeC ₂ O ₄ + H ₂ O and H ₂ O ₂ to form a little of the ferric color complex	Brownish lavender	Light yellow brown
5. Phenol + H ₂ O + FeCl ₃ and stood 48 hours	Yellowish brown	No change
6. Phenol + H ₂ O + CuCl ₂ and stood 48 hours, filtered and filtrate used	Pale yellowish green	No change
7. Phenol + H ₂ O + I ₂ stood 24 hours	Yellow	No change
8. Phenol + H ₂ O + Na ₂ Cr ₂ O ₇ or + NaOH	Light green	No change
9. Phenol + H ₂ O + FeCl ₃ + (NH ₄) ₂ C ₂ O ₄	Brown	Paler brown
10. Alpha naphthol + H ₂ O + NaOH (dilute)	Brown	Darker brown
11. Alpha naphthol + H ₂ O + NH ₄ OH	No darkening with H ₂ O ₂ : Pale greenish brown Not darkened by H ₂ O ₂ : 24 hours later—a murky solution	Darker brown: 24 hours later—a murky solution
12. Alpha naphthol + H ₂ O + C ₆ H ₅ OH + NH ₄ OH	Green	Murky liquid, tar-like fluid residue at bottom: 24 hours later, no change
13. Alpha naphthol-ferric chloride complex + ether and dissolved in oil	Rose purple	No appreciable change
14. Brominated derivative of alpha naphthol ferric chloride complex + ether and dissolved in oil	Deep purple	No change
15. Beta naphthol + H ₂ O + FeCl ₃ + HCl	Bright yellow green	No change
16. Beta naphthol + H ₂ O + CH ₃ OH + FeCl ₃	Blue green A precipitate gathcred in both blank and exposed samples	No change
17. Martius yellow (free acid) + H ₂ O	Pale greenish yellow	No change
18. Martius yellow + H ₂ O + NaOH	Bright yellow	No change
19. Martius yellow + H ₂ O + NH ₄ OH	Yellow	No change
20. Martius yellow + H ₂ O + NH ₄ OH + CoCl ₂	Red brown Brownish precipitate formed	Brownish precipitate formed

Substance	Color before irradiation	Color after irradiation
21. Resorcin + H ₂ O + FeCl ₂	Purple—fades after a few days	Lavender
22. Resorcin + H ₂ O + CuCl ₂	Pale greenish brown	More of a yellowish brown with a precipitate formed
23. Resorcin + H ₂ O + NaOH	Brownish yellow	Orange brown
24. Resorcin + H ₂ O + NH ₄ OH	Light yellowish green	Deeper green
25. Resorcin + H ₂ O + NaOH + urea and heated to boiling	Olive green Stable over night. Not stable over 3 days Not darkened by H ₂ O ₂	Dark olive green
26. Resorcin + H ₂ O + NaOH + pyridine and heated to boiling	Dark olive green Stable for over a week in a corked bottle	Darker olive green
27. Resorcin + H ₂ O + NH ₄ OH + CuCl ₂	Purple	Reddish purple
28. Resorcin + H ₂ O + I ₂ + KI + NaOH	Yellowish olive green Unstable for long periods	Dark olive green
29. Resorcin + H ₂ O + FeCl ₂ + H ₂ O ₂	Yellow brown	No change
30. Resorcin + H ₂ O + bleaching powder	Light reddish brown	Slight darkening
31. Resorcin + H ₂ O + Ca(OH) ₂	Colorless	No change
32. Resorcin + H ₂ O + Hg Cl ₂	Colorless	No change
33. Pyrogallol + H ₂ O + FeCl ₂	Red—soon turned gray	Gray—no change
34. Pyrogallol + H ₂ O + FeCl ₂ (excess) + H ₂ O ₂	Gray brown	No appreciable change
35. Pyrogallol + H ₂ O + FeCl ₂ + (NH ₄) ₂ C ₂ O ₄	Brownish violet	No change
36. Pyrogallol + H ₂ O + CoCl ₂ + NH ₄ OH + HCl (excess)	Orange brown	No change
37. Gambine—R + H ₂ O + HCl	Olive yellow	No change
38. Gambine—R + H ₂ O + NaOH	Olive yellow	Slight change
39. Gambine—R + H ₂ O + CuCl ₂ + NH ₄ OH (excess)	Olive green	Very slight change
40. Gambine—R + H ₂ O + HCl + CuCl ₂	Brown	Very slightly darker
41. Gambine—R + H ₂ O + HCl + AlCl ₃	Light yellow green	No change
42. Hg salt of Gambine—R + H ₂ O	Light yellow green	No change
43. Fast green + H ₂ O + HCl	Light brownish yellow	No change
44. Fast green + H ₂ O	Light yellowish green	No change
45. Fast green + H ₂ O + NaOH	Apple green	No change
46. Fast green + AlCl ₃ + H ₂ O + NaOH (excess)	Pale green	No change
47. Fast green + H ₂ O + AlCl ₃	Pale bluish green	No change
48. Fast green + H ₂ O + FeCl ₂	Olive green Four hours later—a brownish precipitate formed	Slight change After four hours no precipitate
49. Fast green + H ₂ O + CoCl ₂ + HCl (concentrated)	Pale blue green	Less bluish—more greenish
50. Fast green + H ₂ O + HgCl ₂ + HCl	Pale yellowish brown	No change
51. Fast green + H ₂ O + CuCl ₂ + HCl	Pale olive green	No change
52. Aniline	Reddish brown	Slightly lighter
53. Aniline HCl + aniline + CH ₃ OH + HOH	Yellowish brown	Slightly lighter
54. Aniline + I ₂ + K ₂ Cr ₂ O ₇	Dark blue	A precipitate noticed
55. Aniline HCl + furfural + CH ₃ OH + HOH	Red	No change
56. Nitraniline + CH ₃ OH + HOH + furfural + (NH ₄) ₂ C ₂ O ₄	Red	No change
57. Nitro benzene + CH ₃ OH + H ₂ O + HCl + furfural + (NH ₄) ₂ C ₂ O ₄	Yellow	No change
58. Fuchsin + H ₂ O	Violet red	Paler violet red
59. Fuchsin + H ₂ O + (NH ₄) ₂ C ₂ O ₄	Reddish violet	No change
60. Alizarin + H ₂ O + NaOH	Pale purple	Paler purple
61. Alizarin + H ₂ O + NH ₄ OH	Reddish purple	Redder—less bluish
62. Alizarin yellow (Na salt) + H ₂ O	Pale olive yellow H ₂ O ₂ makes it colorless	Slightly paler
63. Alizarin yellow (Na salt) + H ₂ O + NaOH (concentrated solution)	Olive yellow	No change
64. Alizarin yellow + H ₂ O + NH ₄ OH (concentrated solution)	Olive yellow	No change
65. Alizarin yellow (Na salt) + H ₂ O + FeCl ₂	Olive brown	Slight change
66. Alizarin yellow + H ₂ O + CuCl ₂	Pale brown	No appreciable change

Substance	Color before irradiation	Color after irradiation
67. Alizarin yellow + H ₂ O + CoCl ₂	Reddish brown	No change
68. Alizarin yellow + H ₂ O + NH ₄ OH + (NH ₄) ₂ C ₂ O ₄	Pale olive yellow	No change
69. Mercury salt of alizarin yellow + H ₂ O + HCl	Orange brown	No change
70. Benzo purpurin + NH ₄ OH + H ₂ O	Red orange	No change
71. Benzo purpurin + HCl + CH ₃ OH + H ₂ O	Blue	No change
72. Benzo purpurin + H ₂ O + HCl (very dilute acid)	Dark lavender	Very slightly lighter
73. Benzo purpurin + H ₂ O + HgCl ₂ (saturated)	Dull red	Slightly lighter; a few flakes of a precipitate formed
74. Phenolphthalein + H ₂ O + NH ₄ OH	Red violet	No change
75. Phenolphthalein + H ₂ O + NH ₄ OH (very dilute solution)	Pale lavender	Slightly paler
76. Phenolphthalein + H ₂ O + NaOH; very dilute and small concentration of (OH)	Light violet	Light dull red
77. Phenolphthalein + H ₂ O + (NH ₄) ₂ C ₂ O ₄ + NaOH	Pale violet	Very slightly paler
78. Fluorescein (free acid) + H ₂ O	Yellow with greenish fluorescence	Slight change
79. Fluorescein + H ₂ O + NaOH	Yellow—much greenish fluorescence	No change
80. Fluorescein + H ₂ O + HCl	Yellow	No change
81. Fluorescein + H ₂ O + HCl + CuCl ₂	Greenish yellow	No change
82. Fluorescein + H ₂ O + NH ₄ OH + CuCl ₂	Olive green	Olive brown
83. Tetra acetoxy mercury fluorescein + H ₂ O + NaOH	Reddish brown precipitate slowly formed	No change
84. Fluorescein + H ₂ O + FeCl ₃	Olive yellow precipitate formed	No precipitate
85. Fluorescein + H ₂ O + CoCl ₂	Brownish red	No precipitate
86. Fluorescein + H ₂ O + (NH ₄) ₂ C ₂ O ₄	Yellow	No change
87. Eosin (free acid) + H ₂ O (saturated solution)	Pink	No appreciable change
88. Eosin + H ₂ O + NaOH	Pink	Very slightly duller
89. Eosin + H ₂ O + HCl	Light pink	No change
90. Eosin + H ₂ O + FeCl ₃	Dull pink	Very slightly duller
91. Eosin (free acid) + H ₂ O + CoCl ₂	Lavender pink	No appreciable change
92. Acetoxy mercury eosin	Red	No change
93. Eosin + H ₂ O + HCl + (NH ₄) ₂ C ₂ O ₄	Pale pink	Lighter red
94. Erythrosin (free acid) + H ₂ O (saturated solution)		Red precipitate formed
95. Erythrosin + H ₂ O + NaOH	Rose pink	No change
96. Erythrosin (free acid) + H ₂ O + FeCl ₃	Brownish pink	No change
97. Acetoxy mercury erythrosin + H ₂ O	Orange pink	Slightly lighter
98. Mercurochrome-220 + H ₂ O (concentrated solution)	Reddish pink	Paler color due to formation of heavy red precipitate
99. Mercurochrome-220 + H ₂ O (very dilute solution)	Reddish brown	No change
100. Tri-acetoxy mercury phenolphthalein + H ₂ O + NaOH (dilute solution nearly neutral)	Light lavender against a white background	Very slightly paler
101. Tri-acetoxy mercury phenolphthalein + H ₂ O + NaOH (concentrated NaOH solution)	Red violet	Slight change
102. Tri-acetoxy mercury phenolphthalein + H ₂ O + NH ₄ OH	Dull violet	Slight change
103. Tri-acetoxy mercury phenolphthalein + H ₂ O + NH ₄ OH (concentrated)	Dull violet	More reddish
104. Tri-acetoxy mercury phenolphthalein + H ₂ O + NaOH + (NH ₄) ₂ C ₂ O ₄	Lavender	One hour later—colorless, with greenish fluorescence
105. Tri-acetoxy mercury phenolphthalein + H ₂ O + ZnCl ₂ (very dilute)	Dull lavender	Reddish lavender—too concentrated to show much fluorescence
	Very pale lavender	Colorless—greenish fluorescence

Substance	Color before irradiation	Color after irradiation
106. Methylene blue + H ₂ O	Azure blue	Paler blue
107. Methylene blue + H ₂ O + HCl	Pale blue	Paler blue
108. Methylene blue + H ₂ O + NaOH	Pale purple	Paler violet
109. Methylene blue + H ₂ O + FeCl ₃	Bright yellowish green	Yellowish green; next day —more yellowish
110. Indigo + H ₂ O	Light ultramarine	Pale grayish blue
111. Indigo + H ₂ O + HCl	Light ultramarine	Pale grayish blue
112. Indigo + H ₂ O + NaOH (very dilute solution)	Light yellow	Colorless
113. Indigo + H ₂ O + NaOH (more concentrated solution)	Olive yellow	Pale greenish yellow
114. Indigo + H ₂ O + HCl + HgCl ₂	Pale blue	Paler blue

All the experimental work took place at 50 kilovolts and 1.4 milliamperes. In the following experiments the time of exposure was changed from the standard of 10 minutes.

Substance	Time (Min.)	Color before irradiation	Color after irradiation
115. Aniline + H ₂ O + I ₂ + HCl + HNO ₃ + KClO ₃	15	Green	No change
116. Aniline + HNO ₃ + HCl + NaNO ₂ + H ₂ O	15	Reddish brown	No change
117. Fluorescein (free acid) + H ₂ O (saturated solution)	15	Yellow	Very slight change
118. Fuchsin + H ₂ O	20	Red	Lighter red; H ₂ O ₂ did not darken
119. Mercurochrome 220 + H ₂ O (saturated solution)	20	Orange red	No appreciable change
120. Fluorescein + H ₂ O	20	Yellow	Very slight change
121. Methyl orange + H ₂ O + NaOH	30	Orange	No change
122. Methyl orange + H ₂ O + HCl	30	Red	No change
123. Methylene blue + H ₂ O	20	Blue	Very light blue
124. Methylene blue + H ₂ O + acetone (few drops)	20	Blue—same as above	Light blue; acetone tends to prevent color change
125. Fluorescein (free acid) + H ₂ O (saturated solution)	30	Yellow	Very slight change
126. Fluorescein + H ₂ O + HCl (saturated solution)	30	Yellow—no fluorescence	Slight change Heavy precipitate
127. Fluorescein + H ₂ O + NaOH	30	Brownish yellow	No change

Phenol plus ferric chloride in aqueous solution formed a complex color (1) quite unstable at room temperature and eventually becoming a brown-colored solution which by itself gives no further visible color changes when exposed to X-rays under the mild test conditions (5). In general, the ferric chloride phenol complex is unstable in the presence of soluble oxalates such as oxalic acid and sodium oxalate. This color, then, is more sensitive to the presence of these compounds than Eder's solution (1, 2). In the ferrous oxalate experiment (4), the magnitude of the color change was great because of the small concentration of the fer-

ric phenol complex and the presence of excess but slightly soluble ferrous oxalate. In the ammonium oxalate experiment (9), a slight color tinge remained which returned upon the addition of hydrogen peroxide after the irradiation. These results tend to show that X-rays may give an unstable aggregation a transition toward stability.

The purple ferric chloride color with alpha naphthol is insoluble in water and hence the results (12, 13) are incomparable. However, in any study of the structures involved, alpha naphthol becomes exceedingly important as a starting point because the molecule, like phenol, presumably contains

Substance	Color before irradiation	Color after irradiation
67. Alizarin yellow + H_2O + $CoCl_2$	Reddish brown	No change
68. Alizarin yellow + H_2O + NH_4OH + $(NH_4)_2 C_2O_4$	Pale olive yellow	No change
69. Mercury salt of alizarin yellow + H_2O + HCl	Orange brown	No change
70. Benzo purpurin + NH_4OH + H_2O	Rcd orange	No change
71. Benzo purpurin + HCl + CH_3OH + H_2O	Blue	No change
72. Benzo purpurin + H_2O + HCl (very dilute acid)	Dark lavender	Very slightly lighter
73. Benzo purpurin + H_2O + $HgCl_2$ (saturated)	Dull red	Slightly lighter; a few flakes of a precipitate formed
74. Phenolphthalein + H_2O + NH_4OH	Red violet	No change
75. Phenolphthalein + H_2O + NH_4OH (very dilute solution)	Pale lavender	Slightly paler
76. Phenolphthalein + H_2O + $NaOH$; very dilute and small concentration of (OH^-)	Light violet	Light dull red
77. Phenolphthalein + H_2O + $(NH_4)_2 C_2O_4$ + $NaOH$	Pale violet	Very slightly paler
78. Fluorescein (free acid) + H_2O	Yellow with greenish fluorescence	Slight change
79. Fluorescein + H_2O + $NaOH$	Yellow—much greenish fluorescence	No change
80. Fluorescein + H_2O + HCl	Yellow	No change
81. Fluorescein + H_2O + HCl + $CuCl_2$	Greenish yellow	No change
82. Fluorescein + H_2O + NH_4OH + $CuCl_2$	Olive green	Olive brown
83. Tetra acetoxy mercury fluorescein + H_2O + $NaOH$	Reddish brown precipitate slowly formed	No change
84. Fluorescein + H_2O + $FeCl_3$	Olive yellow precipitate formed	No precipitate
85. Fluorescein + H_2O + $CoCl_2$	Brownish red	No precipitate
86. Fluorescein + H_2O + $(NH_4)_2 C_2O_4$	Yellow	No change
87. Eosin (free acid) + H_2O (saturated solution)	Pink	No appreciable change
88. Eosin + H_2O + $NaOH$	Pink	Very slightly duller
89. Eosin + H_2O + HCl	Light pink	No change
90. Eosin + H_2O + $FeCl_3$	Dull pink	Very slightly duller
91. Eosin (free acid) + H_2O + $CoCl_2$	Lavender pink	No appreciable change
92. Acetoxy mercury eosin	Red	No change
93. Eosin + H_2O + HCl + $(NH_4)_2 C_2O_4$	Pale pink	Lighter red
94. Erythrosin (free acid) + H_2O (saturated solution)	Rose pink	Red precipitate formed
95. Erythrosin + H_2O + $NaOH$	Brownish pink	No change
96. Erythrosin (free acid) + H_2O + $FeCl_3$	Orange pink	No change
97. Acetoxy mercury erythrosin + H_2O	Reddish pink	Slightly lighter
98. Mercurochrome-220 + H_2O (concentrated solution)	Reddish brown	Paler color due to formation of heavy red precipitate
99. Mercurochrome-220 + H_2O (very dilute solution)	Light lavender against a white background	No change
100. Tri-acetoxy mercury phenolphthalein + H_2O + $NaOH$ (dilute solution nearly neutral)	Red violet	Very slightly paler
101. Tri-acetoxy mercury phenolphthalein + H_2O + $NaOH$ (concentrated $NaOH$ solution)	Dull violet	Slight change
102. Tri-acetoxy mercury phenolphthalein + H_2O + NH_4OH	Dull violet	Slight change
103. Tri-acetoxy mercury phenolphthalein + H_2O + NH_4OH (concentrated)	Lavender	More reddish
104. Tri-acetoxy mercury phenolphthalein + H_2O + $NaOH$ + $(NH_4)_2 C_2O_4$	Dull lavender	One hour later—colorless, with greenish fluorescence
105. Tri-acetoxy mercury phenolphthalein + H_2O + $ZnCl_2$ (very dilute)	Very pale lavender	Reddish lavender—too concentrated to show much fluorescence

The phthaleins constitute a well investigated type of dye structure which is known to exist in several tautomeric modifications. Only slight color changes were obtained with phenolphthalein (74-77) and these were visible only in very dilute solutions. Here again ammonium oxalate seemed to have an inhibiting effect on the reaction. Fluorescein in general furnished no appreciable color changes except for a metallic lake. Eosin and erythrosin were stable under the test conditions. The mercury derivatives (92, 97) probably simply precipitated from supersaturated solutions.

Many of the color changes in the X-ray exposures were obtained with metallic lakes. In some cases, as with phenol and resorcin colors, the metals formed unstable intermediate colors of different hue along the path toward equilibrium. This type of metallic color upon exposure to X-rays should give color changes of large magnitude provided the length of time necessary to reach equilibrium is neither too long nor too short. In other cases the metals were probably present only in solution along with the color. Where pH changes alter the stability of the color, the most important effect is probably that of a buffer. When this action is not important any different color changes in this type of solution are probably caused by the difference between absorptive effects on the primary radiation and any effects of secondary radiation emitted at other energy levels. Also a highly colored metallic ion may obscure other color changes taking place. Most solutions tested which were obviously of this type gave color changes less in magnitude than the color itself. Another kind of metallic lake is a stable metallic salt of definite composition. Mercurochrome is the generic name for various mercury substituted dyes of the phthaleins (10). Mercurochrome-220 appeared at least as stable as, if not more so than, either fluorescein or eosin. However, phenolphthalein which is

red has a tri-acetoxy mercury derivative which possesses a deep purple color while the di-mercury derivative more closely resembles the parent substance in color. The tri-acetoxy mercury phenolphthalein samples (100-105) became more reddish upon exposure to X-rays. Some of the exposed samples faded out a few hours after treatment, suggesting the possibility of a secondary reaction. Although the color is too unstable for practical use in dosage measurements, the results do show that in general when the color difference between the parent dye and the metallic salt is large in magnitude the prospects for a visible change upon exposure to X-rays are far better.

Stenstrom and Lohmann (9) carried out an extensive series of tests upon methylene blue and showed that a small amount of acetone decreased the sensitivity of the dye toward X-rays, thus demonstrating the importance of the environment in these reactions. Methylene blue (106-109) (123-124) also changed color extensively in caustic as well as in neutral and acid solutions, evidently but slightly affected by pH change so far as the lability of the susceptible bonds in the molecule are concerned. Indigo (110-114) also changed color over a wide pH range although it appeared more sensitive in the yellow basic solution. Several experiments were made with methyl orange (121-122) without success. Also fuchsin and indigo have about the same color change both in aerated and freshly boiled distilled water.

Many of the experimentally visible color changes were predicted from known facts and principles concerning the fundamental structure of the complicated dye molecules, and almost any color change desired is obtainable with the proper structures and substituent groups. Most changes obtained here belong to the color-fade class, which is a disadvantage in the use of the pure dye alone. However, one can easily use mixtures of two or more colors each affected dif-

but one reactive group. The sodium and ammonium salts in a basic solution when exposed to the X-rays had a color change which was not duplicated by the addition of hydrogen peroxide. In the ammoniacal sample (11), a murky greenish white colored solution formed upon standing for twenty-four hours in both unexposed and exposed samples. In (12) the addition of ethyl alcohol simply caused more alpha naphthol to dissolve with the consequent formation during exposure of a dark semi-fluid decomposition product in sufficient quantity to settle toward the bottom. This is presumably the cause of the darkening occurring in the less concentrated solutions. Martius yellow, a nitro derivative of alpha naphthol, neither changed color nor formed a precipitate in dilute solutions under the test exposure to X-rays. Since this derivative has a greater coloring power than alpha naphthol the substituent nitro groups evidently altered the lability of the previously reactive bonds toward mild radiation impulses at the energy level of X-rays.

Resorcin contains two reactive groups and should display a reactivity similar to phenol plus the further effect of the second active group. These resorcin complex colors furnished some good color changes, although, in general, they are unstable over long time intervals.

Gambine—R or alpha—naphthaquinone oxime, has a simple structure for a color and seemed in general quite stable toward the standard irradiation as shown by color change. Fast green in general also showed stability.

Aniline and similar compounds compose the basis of a large number of dyes and colors. Also the fact that aniline seems most easily oxidized to colored complexes and compounds in solutions containing some of the mineral acids indicates that the lability of certain bonds was shifted towards sensitivity to oxidizing reactions. The colors produced vary from red through blue to black,

depending upon conditions and the type of oxidizing agents used. Aniline hydrochloride plus furfural (55) in an aqueous solution forms a brilliant red color which was unchanged by the X-rays. Thus if irradiation could start some reducing reaction selective toward nitro benzene, exposure to X-rays would cause a color formation. Ammonium oxalate was evidently not suitable for this purpose. Fuchsin, a red oxidation product of aniline oil previously tested by Stenstrom (9), faded (58) under the influence of X-rays. Potassium chlorate or hydrogen peroxide (118) when added to the faded sample failed to restore the color, showing that X-rays did not simply reduce the fuchsin to the leuco base. Ammonium oxalate (59), instead of causing this reduction to take place, simply absorbed some of the energy of the radiation without, in turn, affecting the fuchsin. In some tests with fuchsin in dilute solution, the color change at first was not great, but after standing awhile the irradiated sample became practically colorless. This perhaps indicates that some of these color changes are caused by secondary reactions started by the primary X-ray reaction.

Alizarin contains two reactive hydroxyl groups in the ortho position and hence might form colored condensation products. Thus one could expect at first a color change (61) rather than a color fade. Twenty-four hours later the color of the exposed sample had approached the shade of the unexposed blank. Alizarin yellow showed no appreciable color changes. Benzo purpurin, also related to alizarin in structure, changed color less than the latter. However, because of the different coloring powers of these dyes, one must compare them at equal molecular concentrations to draw conclusions as to the effect of the different groups on the lability of the compounds toward color change by X-rays. Such work was considered far beyond the scope of this qualitative survey.

2. Experiments were started upon simple molecules with but one or two reactive groups and were carried through to more complicated structures.

3. Substituent non-metallic groups may change the susceptibility of the labile bond in a simple aromatic structure toward X-ray exposure.

4. Metallic salts and complexes of an aromatic color may give color changes upon exposure to X-rays much different from that of the parent dye, thus vastly increasing the number of possibilities of these changes.

5. Any type of color changes desired, such as color increases, decreases, etc., can be obtained by proper selection of the colors.

6. From the known chemical and physical properties of these compounds, many X-ray color changes can be predicted in advance.

7. The magnitude of the field is such that in all probability the color most suitable

as an intensity indicator has not yet been found.

8. The X-ray in particular and radiation in general furnish one of the most sensitive tools known for the examination of complicated reactions.

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ferently by X-rays to obtain any color change desired. No generalizations based on experimental data secured with pure dyes are at present applicable to the reactions of their colored metallic salts. However, the authors believe that in searching for susceptible compounds of this type one may save time by trying first the colored salts of those heavy metals which exist in two or more valence forms.

The previous work of Clark and Pickett and Stenstrom and Lohmann on methylene blue demonstrates the all-important influence of environment upon the progress of visible color changes in aromatic compounds when exposed to X-rays. Freshly boiled distilled water was simply chosen as perhaps one of the most easily obtainable constant environments which also offered opportunities for changing pH, for using inorganic metallic salts, for obtaining uniform concentrations of the colors, etc. However, there is no proof that aqueous solutions furnish the best surroundings for even a majority of the possible color changes, and perhaps various materials such as cloth, etc., impregnated with changeable colors, offer just as fertile a field for future use. Probably there exist color-producing reactions which take place only while under the influence of X-rays, but the authors preferred to work with simple colors for the sake of simplicity. Also, all experiments were carried out at room temperature, which was considered constant enough for the survey. While some experiments with fuchsin and indigo seemed to give about the same degree of color change in both the aerated and freshly boiled distilled water, some of the others were noticeably different. Experimental work in oxidizing, neutral, and reducing environments may furnish important clues as to the reaction mechanisms in many cases. No such work was attempted here.

Once the environment is disposed of it is obvious that the magnitude of the color change during irradiation depends upon the

lability of the bonds, the concentration of the dye, and the dosage. The dye must have sufficient coloring power for a minute change affecting a comparatively small number of molecules to become visible. Thus the same color change can be used to cover a wide range of X-ray intensities by simply employing the proper amount of color in each case.

In a field as large and as complicated as this one, the authors hesitate to put forward any particular dye or color as undoubtedly possessing better characteristics than all the rest. As a matter of fact, the best colors probably have not been found as yet. Any color, however, to have a wide range of practical applications as an intensity or quantity indicator will have to possess a high degree of stability toward slow reactions, once the standard solutions are made up. However, as a result of the comparative tests, a few fairly stable types of structures dissolved in aqueous solutions seem susceptible to X-rays. They are fuchsin, alizarin in ammoniacal solution, indigo, methylene blue, and perhaps the green resorcin-pyridine color in caustic solution, not mentioning, of course, the vast field of metallic lakes.

Thus X-rays in particular and perhaps radiation in general furnish mankind with one of the most delicate and sensitive tools by which various bonds and linkages in complicated structures can be attacked, and their relative stabilities compared.

SUMMARY

1. A large number of aromatic colors and dyes were exposed to X-rays under the same condition of irradiation, to determine, if possible, some of the general types of structures giving good visible color changes. Some of those showing the most promise from the point of view of stability and degree of color change are the triphenyl methane, alizarin, thiazine, and indigo types.

Townsend method,⁷ the communicated charge is entirely localized in a condenser of constant known capacity, but varied potential difference as determined by a voltmeter. In this, the greatest source of uncertainty is

ionization chamber, and electrometer, together with a calibrated variable capacity which will be described below). One plate of C is connected to earth, while the corresponding plate of C_1 is connected to a

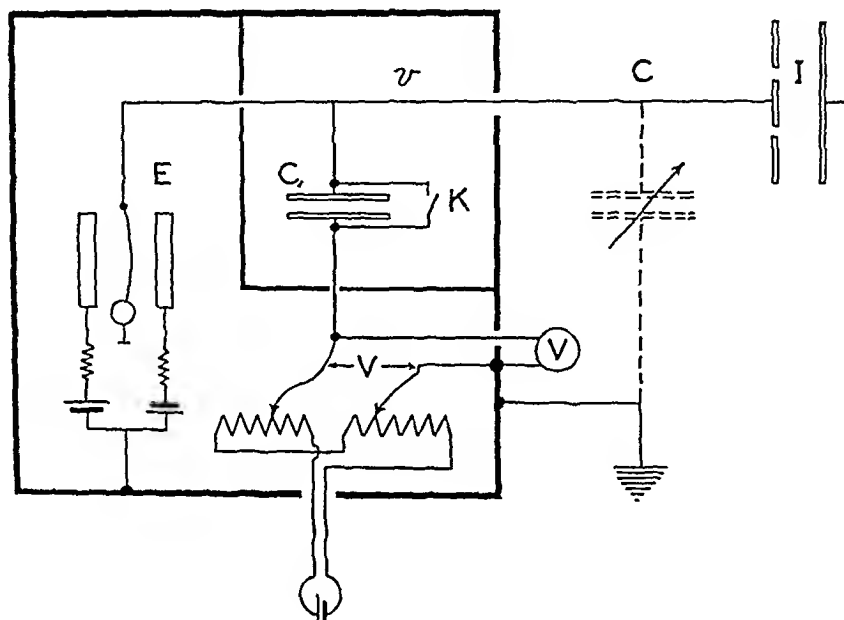


Fig. 1. Null electrostatic system for measuring small charges or currents. The part within the heavy lines is referred to as the "isolated system" and is so constructed that all capacities remain fixed.

the voltmeter, while in the second method it is the variable condenser. Since, in general, a variable condenser suitable for such purposes is a less dependable instrument than a voltmeter, the third method is from this standpoint distinctly preferable to the second.

II. THEORY OF METHOD

1. Measurement of Charge

Given a circuit as represented in Figure 1, an unknown charge is communicated to the system containing an accurately known capacity C_1 and the unknown remainder C (which represents the capacity of the leads,

potentiometer circuit so as to bring it to any desired potential above or below that of the earth. As indicated by the deflection of the electrostatic voltmeter E , this communicated charge raises the insulated side to a calibrated potential v relative to the earth as zero. Calibration of the electrostatic voltmeter is readily carried out by closing the key K and shifting the potentiometer contact to give any desired potential v which is read directly on the voltmeter. (The electrostatic voltmeter can at the same time be adjusted so that the deflection is at the most sensitive part of the scale.) With the electrostatic voltmeter at v , K is opened and an unknown charge Q communicated to the system through, say, the ionization chamber

⁷J. S. Townsend, *Phil. Mag.*, 1930, VI, 598.

ACCURATE MEASUREMENT OF SMALL ELECTRIC CHARGES BY A NULL METHOD¹

By LAURISTON S. TAYLOR, WASHINGTON, D. C.

Abstract.—In the use of an electrostatic system for measuring charges and currents, it is necessary to know the electrostatic capacity of the system. For small capacities the error in this measurement may easily be 1 per cent. There is here described a new method for calibrating a null system in such a manner that the capacity of the leads does not enter and which, therefore, permits a reduction in the

calibration error to one-tenth. When a system is once calibrated in the manner described, any unknown capacity whatever may be added to the leads without affecting the measurement of the desired quantities. Expressions are given for the sensitivity of the system in terms of readily measured quantities. Applications to the measurements of current, charge, and capacity are discussed.

I. INTRODUCTION

WHEN making accurate measurements of small charges or currents by electrostatic means one of the greatest difficulties encountered is that of correctly determining the capacity of the system. This is due largely to the inability, without taking elaborate precautions, to determine corrections for the capacity of the leads from the capacity bridge to the electrometer system. These errors have been discussed in detail by Rosa and Dorsey,² who showed that for capacities of the order of 500 cm. they might be as much as 1.0 per cent. This difficulty has been encountered in endeavoring to make accurate measurements of the ionization produced in air by X-rays, in connection with the International Unit of X-ray quantity—the roentgen.

Investigators have used several different means of measuring the small currents involved. The factors favoring the use of an electrostatic measuring system have been discussed and it has been shown^{3, 4} that the null electrostatic method, in that it does not

introduce field distortion in the ionization chamber, has an advantage over deflection methods. An additional difficulty in deflection electrostatic systems of small capacity arises from the motion of the leaf or fiber altering the capacity and thereby the calibration.

In null electrostatic measuring systems the potential of the electrometer and collecting system is maintained at some constant value—usually zero with respect to ground—by one of three methods. One method of accomplishing this is by communicating to the collector system an evaluated charge or current opposite in sign to that measured. Failla⁵ and Jaeger⁶ have devised sources of current for this purpose which serve as working standards. For absolute measurements this method is impractical because the working standard requires a calibration in kind. In the second method, the charge accumulated on the collector system is compensated by increasing its capacity to maintain the potential constant. Aside from the mechanical difficulties involved in a circuit of this kind, it has the disadvantage of necessitating an elaborate calibration. In a third method, sometimes known as the

¹See first footnote, *RADIOLOGY*, January, 1931, XVI, 9.
²E. B. Rosa and N. E. Dorsey, *Bureau of Standards Bull.*, III, 433.

³G. Failla, *Am. Jour. Roentgenol. and Rad. Ther.*, January, 1929, XXI, 47.

⁴L. S. Taylor, *Bureau of Standards Jour. Research* (R. P. 56), 1929, II, 771; *RADIOLOGY*, April, 1930, XIV, 372.

⁵G. Failla, *RADIOLOGY*, October, 1930, XV, 437.

⁶R. Jaeger, *Strahlentherapie*, 1929, XXXIII, 542.

in no way dependent upon the remainder of the system, and may be considered as known.

As to the other factor, $\frac{\Delta v}{\Delta Q}$, the sensitivity of the compensating system, we have (from

value of C_1 is supposed to be accurately known; leaving C , which includes all capacity of the circuit external to C_1 to be evaluated in terms of observed magnitudes.

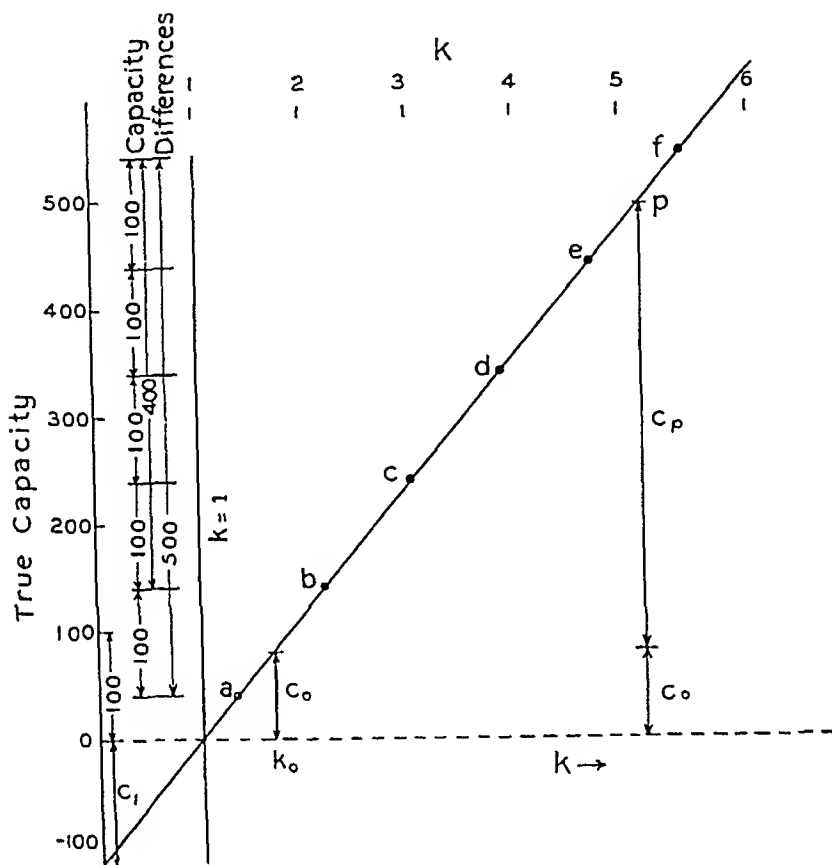


Fig. 2. Schematic method of evaluating fixed capacity C_1 .

the general law $Q = CV$) $\Delta Q = C \Delta V$. Any error Δv in the adjustment of the potential v introduces an error ΔQ , which is given in this case by

$$\Delta Q = (C_1 + C) \Delta v \quad (6)$$

That is, the error in the determined magnitude Q is proportional to the total capacity of the system.

The uncertainty, Δv , may readily be obtained by comparing the electroscopie independently with an adequate voltmeter; the

From Equation (2)

$$\frac{C_1 + C}{C_1} = \frac{V}{v} \quad (7)$$

hence Equation (6) may be rewritten

$$\Delta Q = C_1 \frac{V}{v} \Delta v \quad (8)$$

which in turn, since from Equation (7) $\frac{V}{v}$ is a constant (say k) of the system as given, may be written

$$\Delta Q = C_1 k \Delta v$$

I. This requires the potentiometer contact to be shifted to V in order to bring back to, or maintain, the potential of the system, at the calibrated value v , as indicated by the electroscope.

Since v is unchanged by this operation the charge on the part of the system of capacity C remains unchanged, hence the entire charge Q is accumulated on C_1 . Its magnitude is readily obtained from the measured values; that is

$$Q = C_1 (v - V) \quad (1)$$

2. Calibration of Condenser

The difficult part of this method lies in the accurate calibration of C_1 . To present an adequate method of calibration is the prime object of the present communication.

C is here made up, in part, by an accurately calibrated variable condenser connected into the system as dotted in the figure. The total capacity *in situ* of this condenser is not accurately known because the leads, etc., introduce an uncertainty. However, its capacity differences are very accurately known.

Starting now with the system uncharged (that is, when V is zero, K is first closed, then opened again), the potentiometer contact is shifted to a value V such that the electroscope indicates accurately any convenient potential v . Since no charge has been communicated to the system by this operation, the induced charge ($-Q$) on the unknown capacity C_1 must be exactly equal and opposite to that (Q) on the unknown remainder of capacity C .

Since

$$-Q = C_1 (v - V)$$

and

$$Q = Cv$$

it follows that

$$C_1 (V - v) = Cv \quad (2)$$

The experiment is now repeated with C changed by an accurately known increment

to a new value C' and V , consequently to a new value V' .

In this case

$$C_1 (V' - v) = C'v \quad (3)$$

Subtracting Equation (3) from Equation (2), C_1 , the desired quantity, is obtained in terms of the accurately known magnitude $(C - C')$, namely,

$$C_1 = (C - C') \frac{v}{V - V'} \quad (4)$$

from which expression all extraneous capacities, such as the ionization chamber, electroscope, and leads are wholly eliminated. Since the capacity of the system varies with the deflection of the electrometer, the same deflection must be used throughout any one calibration. After having determined C_1 , other capacities of unknown value may be inserted in the collector system without in any way affecting its calibration. This is of great practical importance, as shown later.

3. Sensitivity of System

Although, as seen in Equation (1), the quantity of the charge measured does not depend on the magnitude of the distributed capacity C , yet the sensitivity of the measuring system must obviously decrease as C increases.

The sensitivity $\frac{\Delta s}{\Delta Q}$ of this type of null circuit can be expressed in terms of the sensitivity of the integral parts: that is,

$$\frac{\Delta s}{\Delta Q} = \frac{\Delta s}{\Delta v} \cdot \frac{\Delta v}{\Delta Q} \quad (5)$$

where Δs is the increment in scale divisions of the electrometer deflection for a given increment ΔQ of the imparted charge; and at the same time Δv is the increment in volts corresponding to the deflection increment Δs .

The electrometer sensitivity, $\frac{\Delta s}{\Delta v}$, is a magnitude which is obtainable separately, is

but a determination of k with the external capacity inserted.

III. EXPERIMENTAL STUDY

1. Description of System as Used

We will now examine a specific null circuit represented in general by the diagram in Figure 1 and for the isolated part in Figure 3. In this latter, E is a string electrometer of the general Edelmann type in which the deflection of a very fine platinum (Wollaston) wire, under an adjustable tension between the charged knife-edges, is observed by a suitable microscope. The potential on these knife-edges is supplied, through very high protective resistances R , by two 22.5 volt batteries. For any given potential on the knife-edges, the voltage

sensitivity $\frac{\Delta s}{\Delta v}$ of the electrometer is adjusted by varying the tension on the fiber by the micrometer head, H . The sensitivity of this particular instrument can be readily changed from 100 divisions per volt to 0.01 division per volt.

The resistances of the compensating potentiometer are operated by the knobs "coarse" and "fine" on the front of the aluminum box container. Potentiometer, charging batteries, compensating condenser C_1 and the necessary leads are all contained in this box, the electrometer circuit being led out through an amber bushing L . All parts are carefully shielded electrostatically. G is a grounding key and K a switch to short circuit C_1 (for the purpose of calibrating the electrometer). Leads to the potentiometer battery and the voltmeter are in the form of jack and plug at M and N , respectively.

2. Calibration

The capacity used for the calibration of C_1 was a precision variable condenser of

TABLE I.—VARIABLE CONDENSER ALONE

Nominal capacity C	k	Average deviation from mean	Deviation from mean
1	2	3	4
0.0*	1.057	0.0015	Per cent 0.14
43.8	1.120	.0016	.14
97.6	1.185	.0018	.15
175.9	1.279	.0008	.06
254.5	1.378	.0021	.15
313.5	1.470	.0014	.09
412.0	1.569	.0018	.12
490.6	1.666	.0009	.05
		Average.....	.11
VARIABLE CONDENSER + RUBBER CABLE			
215.2**	1.968	0.008	0.36
313.5	2.075	.005	.24
412.0	2.232	.006	.32
		Average.....	.31
VARIABLE CONDENSER, HIGH VOLTAGE			
117.1	1.207	0.005	0.41
195.6	1.303	.003	.23
274.1	1.397	.002	.14
352.8	1.495	.005	.33
431.7	1.590	.004	.25
		Average.....	.27

*Variable condenser actually removed and L covered.

**Capacity of variable condenser only. Full value of C is this plus the unknown capacity of the cable.

well known make; the voltmeter was of the laboratory standard type; the capacity differences and voltmeter were calibrated with an accuracy of 0.1 per cent by the electrical division of this Bureau.

The accuracy of the results obtainable under working conditions is best brought out graphically. The factor k (Equation (9)) may be obtained from the slope of the curve V plotted against v —a series of which curves are given in Figure 4 for several different settings of the variable condenser C .

The first part of Table I gives results of a number of determinations of k for different nominal values of the external capacity C , in which the variable condenser was connected to the terminal L by a well insulated and shielded conductor of unknown capacity. The average deviation of five determinations of each k is seen to be within the 0.1 per cent accuracy of the measuring instruments.

Plotting (circles, Fig. 5, Curve I) these

The sensitivity of the compensating system is then

$$\frac{\Delta v}{\Delta Q} = \frac{1}{C_1 k} \quad (9)$$

in which k is a *sensitivity factor* of the system as given. Since C_1 is constant and known from (4) we have now expressed the sensitivity $\frac{\Delta v}{\Delta Q}$ without C being explicitly involved. The working sensitivity of Equation (5) then becomes

$$\frac{\Delta s}{\Delta Q} = \frac{\Delta s}{\Delta v} \cdot \frac{1}{C_1 k} \quad (10)$$

which, since k increases with the stray capacity C , shows that the sensitivity decreases as the stray capacity increases.

By considering all capacities outside the heavy lines of Figure 1 to be removed from the system, we may determine a value of the sensitivity factor k_0 which is characteristic of the isolated part. Thus

$$k_0 = \frac{V_0}{v_0} \quad (11)$$

serves in practice as a ready control of the system.

4. Method of Operation

Referring to Equation (4), only two capacities whose difference is accurately known are required for the calibration of C_1 . If, however, a variable capacity C having a number of accurately known capacity differences be used for the calibration, the following graphical analysis which gives equal weight to all observations shows readily how to obtain the magnitude of any of the capacities in the system, including C_1 .

Remembering that $\frac{V}{v} = k$, we have from Equation (7)

$$C = C_1 k - C_1 \quad (12)$$

showing a linear relationship between C and k . Here it is seen that C_1 may be obtained either from the slope or from the C intercept; also that $k=1$ when $C=0$; and

finally that for $k=k_0$, C takes on a derived value which will later be found serviceable in the analysis.

In plotting C against k , as in Figure 2, the capacity differences for various settings of C being accurately known while the absolute capacity is yet undetermined, we are unable to assign C its correct coordinate position at the start but merely a place, say a . Then, for a C scale, may be chosen coordinates representing *capacity differences* employed without regard to the location $C=0$.

The next point b , corresponding to a known capacity change from a , is then plotted with reference to a , etc. A straight line drawn through the plotted points must also pass through the point $k=1$, $C=0$ and thus locate the origin. Having determined the position $C=0$ it is now possible to read off the graph the value of the other capacities in the circuit. For example, the isolated system has a determined sensitivity factor k_0 , so that referring to (12) the corresponding ordinate C_0 gives what will be called the stray capacity of the isolated system. Similarly, the difference between the ordinate C_0 and that C_p at any other point P on the curve gives the corresponding capacity of the external system.

Obviously such a system is applicable to the accurate measurement of any inserted capacity; for example, $(C_p - C_0)$. We will consider C as made up of the stray capacity C_0 of the isolated system and the total external capacity C_{ext} . Then Equation (12) becomes

$$C_1 k = C_1 + C_0 + C_{ext} \quad (13)$$

In this, C_1 is determined by Equation (4), C_{ext} is removed, and C_0 is determined from the relation

$$C_1 k_0 = C_1 + C_0 \quad (14)$$

Combining these

$$C_{ext} = C_1 (k - k_0) \quad (15)$$

For any given measuring system, C_1 and C_0 and k_0 remain fixed so that the measurement of any capacity, such as C_{ext} , requires

at the point P , for example, is found to be k_0 in Equation (15), giving $C_p = 459.8 \mu\mu f$.
 $460 \mu\mu f$.

These capacity values may be calculated more accurately from Equations (14) and (15). Using Equation (14) for $k_0 = 1.057$ we find $C_1 + C_0 = 855.3 \mu\mu f$ where, since

3. Factors Affecting Sensitivity

The second part of Table I gives values of k for three nominal values of the variable condenser, to which was connected a

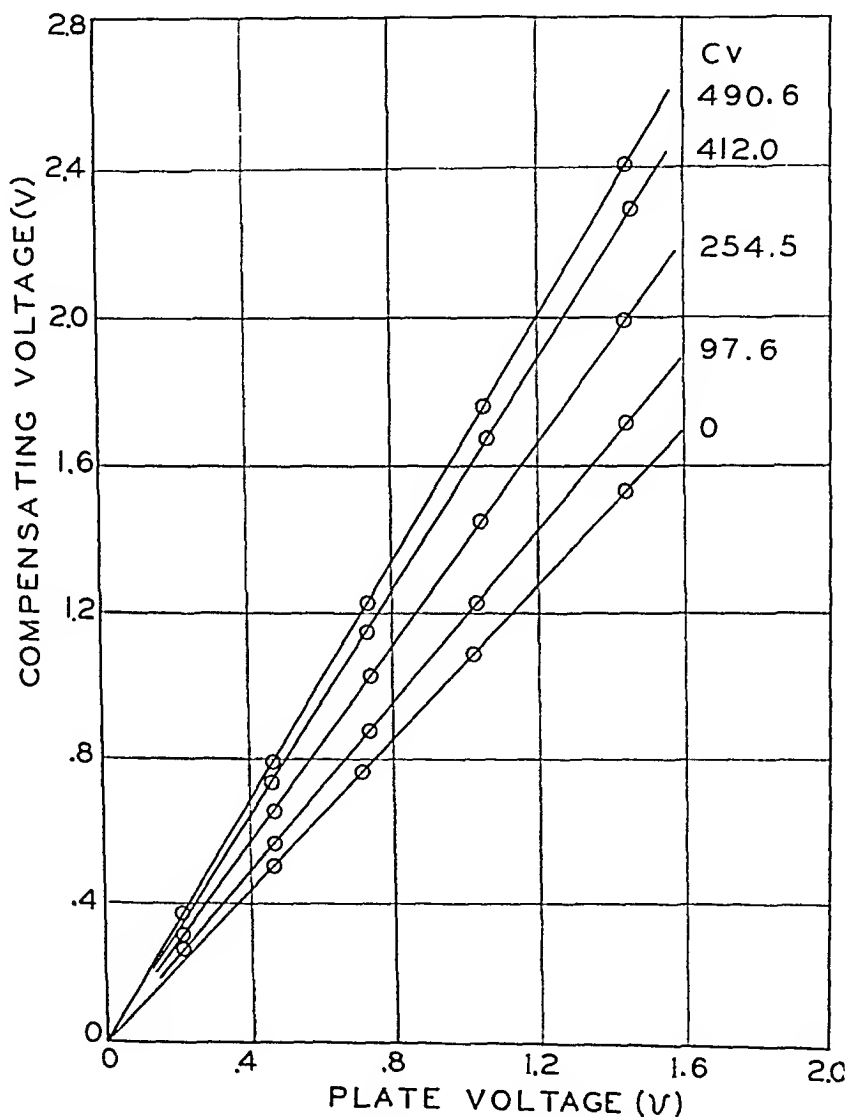


Fig. 4. Curves showing the evaluation of the sensitivity factor k over a range of potentials.

$C_1 = 809.2 \mu\mu f$, we have $C_0 = 46.1 \mu\mu f$. The capacity at C_p for which $k = 1.569$, is obtained by substituting the values of k and

shielded, rubber, single-wire cable of unknown capacity, with the shield grounded to serve as a condenser having a poor dielec-

values of k as abscissæ and the corresponding variable condenser values as ordinates, it is found that all of the points lie closely on a straight line. According to (12) the slope $\Delta C/\Delta k$, which is obtainable in terms

condenser system alone was found to be $1.057 \pm 0.0005 \mu \mu f$.

This curve might be given its coördinate position on a $C-k$ plot by extending it to the point $k = 1$; hence, also, the ordinate

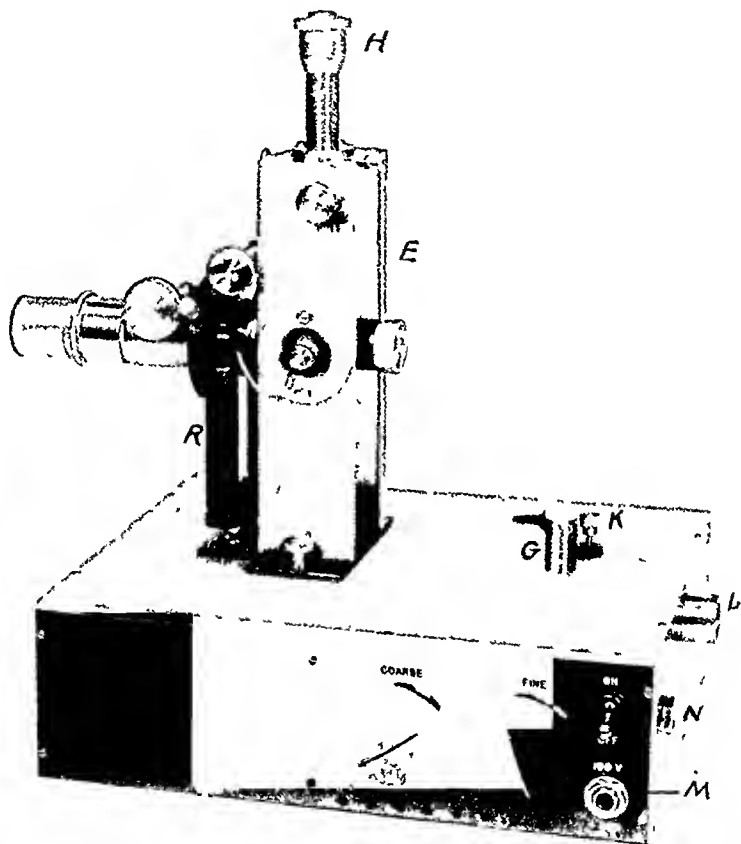


Fig 3 Photograph of "isolated system" as used in the study

of the accurate differences in capacity, gives C_1 as $809.2 \pm 0.4 \mu \mu f$

Having removed the condenser C and covered the amber bushing L with a cap, the sensitivity factor k_0 for the electrometer-

value $C = 0$, located as seen at -48 on the variable condenser scale. The value of the internal lead capacity C_0 may be read from the curve at the point $k = 1.057$, thus giving $C_0 = 46 \mu \mu f$. Likewise the value of C_0

17 divisions per volt; v was never greater than 1.5 volts, and, consequently, the external condenser offered no difficulties due to leakage. However, with v increased to 80 volts and the sensitivity decreased to about 0.3 division per volt, leakage became appreciable and k was subject to error as indicated in the third part of Table I where the average deviation was 0.27 per cent as against 0.11 per cent in the first part. The values obtained are plotted as crosses on Curve I (Fig. 5). Such conditions should, of course, be avoided when determining C_1 .

IV. APPLICATION TO CURRENT MEASUREMENTS

In the measurement of current by this method, a time measurement, of course, enters. In the particular case of measuring X-ray intensities, a shutter in the X-ray beam between tube and ionization chamber is so controlled that it remains open for a definite interval of time during which the charge is wholly compensated, holding $v=0$, by varying the potential on C_1 .^{10, 11}

In practice it is extremely advantageous to use a shielded rubber cable for connecting the electrometer to the source of current. As shown above, the presence of unknown lead capacities does not affect the measured value of the charge, although it does affect the accuracy of the measurement.

The effect of poor insulation may be eliminated by choosing such conditions that $v=0$ with respect to the shielding. This confines leakage to the condenser C_1 , and it is a relatively simple matter to construct this fixed capacity so that leakage between its plates will be negligible. In the isolated part of the system here described, a 20-volt charge on the condenser leaked to ground at the rate of only 3 per cent in 8 hours;

but, with a rubber cable attached, the same leakage occurred in about 10 minutes.

To obtain the desired sensitivity with any length of cable added to the system, the electrometer sensitivity may be changed in accord with k as brought out in Equation (9).

To test the effect of a poor dielectric in the external condenser, two sets of intensity measurements were made of the same X-ray beam, using a standard X-ray ionization chamber.¹² In the first set, the electrometer and ionization chamber were connected by an amber insulated conductor having a capacity of about 206 μmf and negligible leakage. In the second set, the connection was by the shielded rubber cable having a capacity of about 525 μmf . For this the electrometer sensitivity was adjusted to accord with the change in k , approximately double that of the first case. The respective average deviations from the mean of 10 observations for each of the two cases were found to be 0.33 and 0.32 per cent, respectively, the averages of the two runs differing by 0.13 per cent. These deviations from the mean were no more than should be expected from the X-ray intensity variations.

In a null circuit previously described by the author¹³ the expression for the magnitude of the ionization current involved the total capacity C_T of the system instead of simply C_1 as above. The fact that the total capacity C_T can not be measured accurately (with a bridge, as previously done) renders the other method less satisfactory than the present one. Intensity measurements of the same X-ray beam by the two outfits showed a difference of nearly 1 per cent, which is principally attributed to the error in the measurement of C_T . Compared with the average deviation above, of one-third this magnitude for both the highly insulated and the cable connected systems, the superiority of the method here presented is evident.

¹⁰D. L. Webster and A. E. Henning, *Phys. Rev.*, 1923, XXI, 261.

¹¹See footnote 4.

¹²L. S. Taylor and G. Singer, *Bureau of Standards Jour. Research* (R. P. 211), 1930, V, 507; *Radiology*, December, 1930, XV, 637.

¹³See footnote 4.

tric. The fourth column of this part compared with the part above shows that the precision of measurement was not so good—the average deviation changing to 0.31 from 0.11 per cent which, as already stated,

ing C_1 is obvious^a—a conclusion supported also by the fact that, when the cable was replaced by a highly insulated condenser of about the same capacity, the points fell well along a straight line, the slope of which rep-

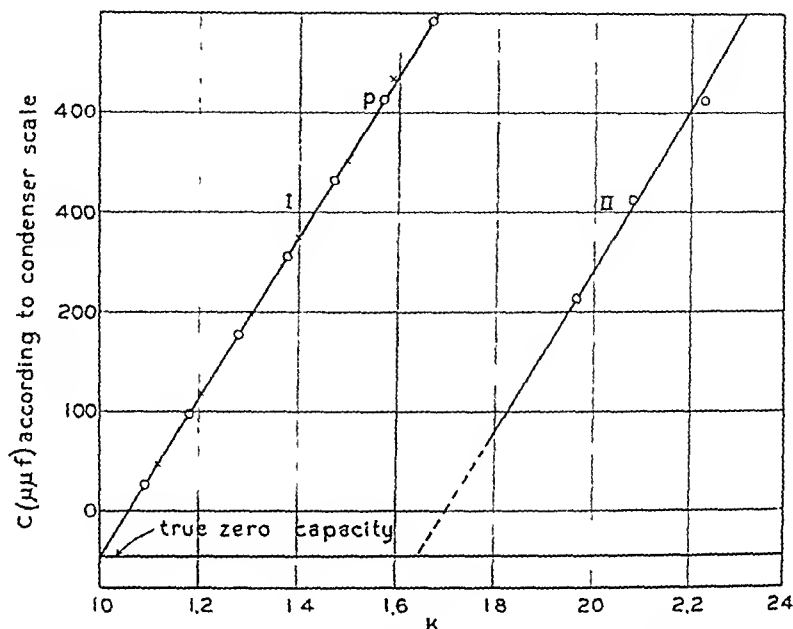


Fig. 5. Curves showing the evaluation of the fixed capacity C_1 by means of an accurate variable external capacity. Curve I (circles) using low voltage, (crosses) using high voltage; Curve II using a rubber cable in the external system.

was the error of calibration. The greater error (0.31 per cent), however, is due to the experimental difficulty in determining k ; for, due to dielectric absorption in the rubber cable, it was difficult to fix with accuracy upon the V necessary to apply to C_1 to induce a definite potential $v/0$ on the electrometer.^a

Reference to the corresponding Curve II in Figure 5 shows the same effect in that the plotted points determined with the cable in the system do not fall closely on the straight line drawn parallel to Curve I. The superiority of conditions when all questionable external capacity is removed while calibrat-

resented satisfactorily the capacity as checked by other means. Furthermore, the average deviation from the mean for the values of k made with the well insulated unknown was 0.12 per cent as against 0.31 per cent for the cable. This small average deviation, being again of the order of the error of the instrument calibration, indicates that the larger deviation (0.31 per cent) for the rubber cable was due to absorption, not to the magnitude of C .

In the measurements for the first and second parts of Table I, the electrometer sensitivities were, respectively, about 13 and

^aThis absorption is not operative when using, as in current measuring, the system at $v = 0$.

^aIt is of interest to note that using Equation (15), the capacity of the cable was found to be 522 μf as compared with 526 μf obtained with a capacity bridge calibrated with an accuracy of 1 per cent.

CLASSIFICATION AND PATHOLOGY

True aneurysms are those in which one or more coats of artery form the walls of the aneurysm. They are divided into three chief groups:

1. Dilatation aneurysms, which consist of a more or less uniform enlargement of the lumen of the aorta, are usually limited to a certain portion of the aorta, resulting in a fusiform or cylindrical aneurysm, but a generalized or diffuse dilatation of the first part of the aorta may occur.

2. Circumscribed saccular aneurysms, which are the most common type, consist of a localized distention or bulging of one side of the aorta, after adequate damage of the intima or media, or both together.

3. Dissecting aneurysms consist of a splitting off of one or more coats, usually the intima, from the remainder of the aortic wall, forming a false tube through which the blood flows. This is a rare type of aneurysm in a pure state, the majority combining a saccular component.

The first group, or dilatation aneurysms, were first described by Hodgson in 1815, and were fully investigated by Thoma (10), who described the pathology (mesaortitis) and named the four chief forms as (1) single fusiform aneurysms, (2) multiple spindle-shaped aneurysms, (3) the saccular added to the spindle form, (4) the tent-shaped or sphenoid. Osler (11) headed a section of his work: "Dilatation Aneurysms of the Aorta (Dilatation of the Aorta—Chronic Aortitis)," thus indicating that he considered chronic aortitis with dilatation to be an aneurysm.

The only difference between the saccular aneurysm and simple dilatation, or arteriectasis, is that given by Kaufmann (12), who, quoting Pommer, states that aneurysm is characterized by a solution of continuity of the elastic tissue of the media, while in arteriectasis (simple dilatation) only a thinning of the media occurs. This means

that in aneurysm there must be a rupture of one or more coats of the aorta—usually of the intima and media together. The dilatation aneurysms have usually no rupture of the aortic coats, and for this reason are not considered by some pathologists to be true aneurysms. For clinical purposes, however, they are always included in the group of aneurysms.

It is obvious that there is no definite way of telling from the roentgen silhouette (or other clinical means) whether or not there is a rupture of one or more coats of the aorta, but probability favors the assumption that in a dilatation of any marked size a rupture of some kind has occurred. The discrepancies between vital and autopsy percentages show that many cases are missed, and many of these must come from the smaller aneurysms because of the comparative ease of diagnosis of most of the large aneurysms.

Saccular aneurysms, even of small size, soon become nearly filled with a deposit of laminated fibrin clot, and hence do not usually pulsate. Dilatation aneurysms, because of their form, do not contain clots until a large size is reached, so their pulsation is usually marked.

Aneurysms are most common in the ascending, transverse, and descending aortic arch. According to Lueke and Rea (13), the most common sites are (1) the ascending arch, (2) the junction of the ascending and transverse arch, (3) the transverse arch, (4) the junction of the transverse and descending arch. Small aneurysms near the sinuses of Valsalva just above the aortic valves are common (14), and frequently rupture into the pericardium. Abdominal aneurysms occur about one-tenth as often as thoracic aortic aneurysms, while aneurysms of the descending thoracic aorta are the most uncommon of all. Dilatation aneurysms are usually regarded as limited to the ascending and arch portions of the aorta,

THE ROENTGEN DIAGNOSIS OF AORTIC ANEURYSM

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THE definite antemortem diagnosis of aortic aneurysm depends entirely upon the direct demonstration of the lesion by roentgenologic methods. The fact that comparative statistics of autopsy and clinical material indicate that many cases escape diagnosis would suggest strongly the advisability of more use of thorough roentgen studies of the cardiovascular syndromes.

Since a knowledge of the pathologic anatomy of aneurysm is essential to successful diagnosis, this part of the subject must be briefly reviewed. An aneurysm is defined by Osler (1) as a tumor containing blood in direct connection with the cavity of the heart, the surface of a valve, or the lumen of an artery. This is expressly said to be not entirely accurate, especially as it does not include the dilatation aneurysms of the aorta.

Aortic aneurysm is by far the most common and important clinical variety, and is not a very uncommon disease. It was found in 2.4 per cent of 16,200 autopsies (2). Of these, the diagnosis had been made clinically in only 43 per cent. Boyd (3) has estimated, on the basis of 4,000 reported cases, that aortic aneurysm is the cause of death in about 0.5 per cent of the deaths in American cities. Lemann (4) reported 47 cases in 25,513 patients (0.3 per cent), and found 67 aortic aneurysms in 2,000 autopsies (3.3 per cent). He believed that the diagnosis was being missed in many cases, as did also Boyd. Additional evidence of this was given recently by Levine (5), who reported 17 cases of aortic aneurysm found at autopsy, of which only 12 had been diagnosed clinically.

ETIOLOGY

Aortic aneurysm results primarily from

a local or diffuse weakening of the walls of the aorta. This is practically always the result of an aortitis, especially of the more chronic types. It is well known that syphilis is the chief cause of all chronic aortitis, and consequently it is usually estimated that from 80 to 90 per cent of all aortic aneurysms are due to syphilis. Among the rarer causes of aortitis (acute and subacute) mentioned by Alburt (6) are: the exanthems, diphtheria, typhoid fever, rheumatic fever, influenza, streptococcus infections, and extensions from a vegetative endocarditis. It is thought that these will only rarely lead to the formation of an aneurysm. The only other agent leading to weakening of the aorta is embolism of the small vessels of the aortic adventitia and vasa vasorum. These are usually infected emboli from a vegetative endocarditis, and hence the aneurysms which may result are known as mycotic aneurysms.

There is general agreement that the common arteriosclerotic changes of the aorta play little or no part in the production of aneurysms. Hypertension and physical overwork are regarded as purely secondary factors, because they can never cause an aneurysm as long as the aorta retains its normal strength and resiliency.

Syphilitic aortitis does not usually occur until several years after the primary infection, but in some cases it may appear within one or two years (7, 8). Lamb (9) states that syphilitic aortitis occurs in 25 per cent of all syphilitics, and that aortic aneurysm occurs in about 30 per cent of all cases of syphilitic aortitis. Since it is generally estimated that from 10 to 20 per cent of the total population is infected with syphilis, it is only surprising that more cases are not found.

of syphilitic involvement. It is limited to syphilitic aortitis, and is not seen in hypertensive or arteriosclerotic aortic disease. It will, therefore, be found in all cases of syphilitic aneurysm, except in those in which the aneurysm grossly deforms the arch. The mechanism of the production of this squared appearance is not definitely understood, but it is probably due to the combined effect of the thrust of the blood column against the weakened walls of the aorta, which appear to weaken at the points of junction to such an extent that sharp turns are produced in place of the normal curve.

The major X-ray evidence of abdominal aortic aneurysms (and sometimes of those of the descending thoracic aorta) will usually be the typical scalloped erosions of the spine seen in the lateral projection, although it is stated (23) that in some cases abdominal aneurysms may produce a large globular shadow which extends up into the chest. In doubtful cases visualization of the esophagus with a barium mixture is a valuable method of outlining the descending aorta, as the esophagus will be pushed forward and displaced to either side by an aneurysm of this region (24).

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

The signs and symptoms resulting from the pressure of a large aneurysm are well known and need not be repeated. In the case of early aneurysms, especially those of the ascending aorta and arch, the chief symptoms are dull substernal pain (sometimes referred to the shoulder), and dyspnea, usually paroxysmal in character. As these are also the symptoms of aortitis, only the roentgen examination can decide whether an aneurysm is present in addition to the aortitis. Hoarseness from laryngeal palsy is common.

The special liability of the trachea and main bronchi (especially the left) to be compressed by pressure from even small anen-

rysms of the transverse and descending aortic arch often produces atelectatic or emphysematous changes in the lungs which can usually be recognized only on the X-ray film. Bronchiectasis may occur distal to the compression and produce X-ray evidence in addition to the usual abundant sputum. Bronchial irritation also produces a chronic and often paroxysmal cough, which, together with the hemoptysis which may occur from repeated small hemorrhages into the respiratory tract, often results in a diagnosis of pulmonary tuberculosis, which was one of the most common false diagnoses found by Boyd (3). Several cases of atelectasis of one or more lobes of the lung from the pressure of an aneurysm have been reported (25, 26), and a case in which this occurred will be described later. In the absence of other evident explanation, atelectasis should always raise the question of aneurysm, especially if the patient is syphilitic. Aortic involvement usually occurs later than cerebrospinal syphilitic involvement (27), so there are often neurological signs of syphilis, such as unequal or Argyll-Robertson pupils, to aid the diagnosis of syphilitic infection.

In the presence of suggestive signs or symptoms, the diagnosis must be made or discarded entirely on the results of the roentgen examination. If findings indicative of aneurysm are found, the differential diagnosis must be made from several conditions which may simulate it closely on the X-ray film. These are chiefly aortitis, mediastinal tumors, lung tumors, and, more rarely, interlobar effusions, cysts of the lung, spinal abscesses, and pericardial diverticula.

The differentiation between aortitis and aortic aneurysm has not received much attention from recent writers on the subject. Most of them seem to require a definite sacculation before making the diagnosis of aneurysm. Thus Kurtz and Eyster (28)

but Neuhoﬀ (15) has reported five cases of dilatation aneurysm occurring in the descending thoracic aorta. These and abdominal aneurysms usually erode the spine, the erosion being characterized by the preservation of the intervertebral discs, so that a scalloped appearance results.

ROENTGEN APPEARANCES

The roentgen appearances of thoracic aortic aneurysms were discussed by Williams in the second edition of his book, issued in 1902, and from this basis the typical findings were organized and clearly stated by Baetjer (16) in 1906. He described the findings, depending on location, as: (1) Aneurysm of the ascending arch casts a shadow more to the right of the sternum, and anterior; (2) aneurysm of the transverse arch casts a shadow slightly to the left of the midline which extends well up into the neck; (3) aneurysm of the descending arch casts a shadow to the left and posterior; (4) the rare aneurysm of the descending aorta near the diaphragm may displace the heart upwards and appear as a pulsating mass to the left of the median line.

These observations are still standard and form the basis for localizing any aortic aneurysm. Köhler (17) has noted that an aneurysm of the descending thoracic aorta may appear as a projection on the right border of the cardiac shadow just above the diaphragm.

A thorough fluoroscopic examination, utilizing both the right and left oblique positions, is indispensable for an examination of the whole length of the aorta and to determine the relation to it of any suspicious areas. To accomplish this satisfactorily it is essential to be familiar with the appearance of both the normal aorta, especially the senile "uncoiling" (18), and the pathologic aorta, particularly the widening and uncoiling which occur so commonly in syphilitic aortitis (19, 20).

The value of observing the presence or absence of pulsation, and its type, in a suspicious mediastinal mass is not very great, because aneurysms may or may not have a systolic, expansile pulsation, depending on the amount of fixation to the surrounding tissues and the extent to which they are filled by a laminated clot (21). Large sacular aneurysms rarely pulsate for this reason, while fusiform (dilatation) aneurysms of the ascending aorta usually have a marked pulsation, because it is only when the aortitis involves the root of the aorta, producing an aortic insufficiency, that a wide expansile pulsation occurs (22). Expansile pulsations, such as are seen in the normal aorta, are sometimes noted in small aneurysms, but they are usually very difficult to distinguish from the pulsations which may occur in mediastinal tumors, either from their vascularity or from transmitted pulsation.

The syphilitic aorta has a characteristic appearance which was first noted and described by Dr. P. M. Hickey. This is the "squaring" of the aortic arch in which the transverse portion turns at a sharp angle from both the ascending and descending portions of the arch, as seen in the direct lateral view. In well marked cases the three sides of a square are thus outlined by the inner border of the aorta, in contrast to the symmetrical curve normally observed. The outer border of the aorta preserves its usual rounded appearance, and the caliber of the aorta is moderately increased throughout the entire arch. The junction of the ascending and transverse portions is the point which first shows the sharp angulation, and it is here that the angulation is always greatest and most distinct. In early cases the right-angled turn is limited to this point, while the junction of the transverse and descending parts is still rounded.

This appearance has been noted in all stages of development, and the extent of the squaring seems to correspond to the degree

able. Thus if the aorta is dilated in the remainder of its length, the mediastinal shadow is probably an aneurysm, while if it seems free from disease aneurysm is not indicated.

Clinical evidence of syphilis, or a positive Kahn or Wassermann reaction, is strong evidence in favor of aneurysm in equivocal cases. Tumors generally grow more rapidly than aneurysms, but the best test in doubtful cases is to give one or two full value test irradiations, which will cause a rapid retrogression in size in practically every mediastinal tumor, while the size of an aneurysm will not be affected. These test radiations should be employed in every doubtful case, because of the unequivocal manner in which they make clear the diagnosis.

Primary lung tumors of bronchial origin do not often cause confusion with aneurysm. The infiltrating border which they usually possess is sufficient in most cases to prevent any confusion. Nevertheless, in the exceptional case when the tumor has a smooth border and the aorta is dilated, mistakes can occur (Case 4). The atelectasis which these growths are so prone to produce (together with aneurysms) may lead to their being erroneously diagnosed when none is present (Case 3). Aneurysm should always be considered when unexplained atelectasis is present.

The tumor masses of the mediastinum and of the hilar regions are the only conditions which will ordinarily be confused with aneurysm, but at times some lesions of the lung parenchyma, the spine, or the heart itself may cause difficulty. Vaquez and Bordet (32) state that right interlobar effusions may sometimes simulate a large aneurysm. The lower position of the inferior contour of the shadow cast by an effusion, and the usual sharp localization in the oblique and lateral views, are said to be the chief points of differentiation from aneurysms. The same authors state also that

hydatid and dermoid cysts of the upper and medial portions of the lung may be mistaken for aneurysms, although their clearly circular form is usually sufficient for identification.

In exceptional cases the shadow of a thoracic Pott's disease may resemble that of an aneurysm. The Pott's abscess has usually a mottled character from the presence of bony debris, and detailed examination of the spine will always show the spinal disease and make the diagnosis clear. Cardiac aneurysms are very rare, and careful fluoroscopic examination should be sufficient to establish their nature. Another interesting though rare cardiac condition which should be differentiated from aneurysm has recently been reported (33). This is the pericardial diverticulum, and it is said to have the following roentgen findings: (a) *positive*—diffuse cardiac enlargement, together with an abnormal shadow at its right border; (b) *negative*—normal lungs and aorta, and persistence of the positive finding on repeated examinations.

The chief difficulty in differential diagnosis, however, and the one which should be emphasized, is that of distinguishing between aortitis and early aneurysm, especially of the fusiform type. The characteristic appearance of an aneurysm, *i.e.*, a localized sac formation which may or may not pulsate, is seen only in advanced cases, except in those which form sacculations in the initial stage of the pathological process. These could not ordinarily cause confusion with the concentric dilatation of aortitis. Early fusiform aneurysms result in the formation of local and general dilatations which are entirely similar to those occurring in advanced grades of aortitis. This is as would be expected, because the pathologic process is the same in both cases.

Aneurysms of this type will increase slowly in size, forming a progressively larger dilatation, until an organized blood clot has

state: "In cases where the aortitis has progressed to such an extent that aneurysm formation has occurred, a localized area of sacculatation can be visualized under the fluoroscope and the diagnosis definitely confirmed." Such a requirement would not recognize a fusiform or diffuse aneurysm until a very large size had been reached. Steel (29), in describing the findings of syphilitic aortitis, mentions "irregular and also general dilatation," and later says, "Localized dilatations are common and are probably due to the disruption of the elastic fibers so common in luetic aortitis," but does not mention that an early fusiform aneurysm has exactly the same appearance. Samuel (23) appreciates the difficulty and says, "Observers differ, and what appears to be a dilatation to one is an aneurysm to another," and adds, "early recognition (of an aneurysm) is important for prognosis because if it is seen early, the outlook is better."

This is the chief reason why an attempt should be made to distinguish more clearly between aortitis and aneurysm, or at least to recognize the latter as early as possible, for it is obvious that in many cases it will be impossible to say when aneurysm formation has actually begun. The fact that the prognosis of aneurysm is much better when discovered early (and the patient put on a proper regimen) has been emphasized by several writers.

Baetjer in his original paper declared that aortitis could be distinguished from aneurysm by the fact that in aortitis the abnormal widening receded between pulsations, while in aneurysm the widening remained unaltered between pulsations. This observation was repeated by Carman (30) in 1912, but since then I have been unable to find any reference to this method in the literature. The reasons for it being discarded are not very clear, but it was probably found not to hold true in all instances.

If it were a valid distinction it would certainly be most valuable, as there is at present no way of distinguishing between simple dilatation and small fusiform aneurysms. It would seem to be preferable to err on the side of radicalism, for to treat a case of aortitis for aneurysm would do no harm (and probably do good as a prophylactic measure), while to treat a patient with aneurysm only for aortitis might shorten his life more than necessary.

Mediastinal tumors are sometimes differentiated from aneurysm only with great difficulty. In the usual case the characteristics of a mediastinal tumor are sufficiently marked to separate them clearly from aneurysm, but in exceptional cases this will not hold true. The shadow of a mediastinal tumor is usually dense and homogeneous, and the borders are usually clear-cut and distinctly lobulated. It is only rarely that an infiltrating border is observed, but an irregularity due to "lobulation" is the common finding. In contrast, the border of an aneurysm is smooth and curved.

The density of the aorta is usually greater than that of mediastinal tumor, and hence the aorta can frequently be distinguished from the shadow cast by a mediastinal tumor. Tumors of the mediastinum, when of large enough size to be confused with aneurysm, usually extend out from the hila on both sides unequally, but the inequality rarely takes the form of what Kienböck (31) considers to be a characteristic "aortic asymmetry," which is due to the inequality of the projection of the aneurysmal sac to the right and left sides. He adds that if the upper and lower points on both sides are connected by slightly curved lines an "aortic oval" always is formed which points obliquely upward to the left with its long axis running from right and below to left and above. The "Thoma-Kienböck rule," which states that an aneurysm hardly ever occurs in an otherwise normal aorta, is also valu-



Fig. 1, Case 1. Diffuse or dilatation aneurysm of the arch and ascending aorta.

Fig. 2, Case 2. Aneurysm of the arch. The aortic oval of Kienböck is outlined. Note that the long axis runs from right and below to left and above.

final clinical diagnosis in all but two instances (Cases 3 and 4), and also discovered two early dissecting aneurysms not suspected on clinical or roentgen examinations. Such a small number of proved cases is obviously inadequate to give any indication of the relative accuracy of the clinical methods of diagnosis.

In order to determine as far as possible the part played by the roentgen study in arriving at the final diagnosis, the cases were grouped into four classes. In the first class were placed those cases in which the clinical history and examination had suggested the possibility of aortic aneurysm, and the roentgenographic study had confirmed and given definite validity to the clinical impression. In this group were placed 42 cases, or 54.5 per cent, so that it constituted the most numerous one, as might be expected. In the second class were

placed those in which the clinical examination had raised no question of aortic aneurysm, and in which an aneurysm was demonstrated during the roentgen study undertaken for other reasons. Twenty-two cases, or 28.5 per cent, fell into this group. In the third group were placed those in which the diagnosis was made entirely upon the clinical findings, the roentgen examination being negative or entirely omitted. Nine cases, or 11.5 per cent, were included in this class, in four of which no roentgenographic study was made, while the remaining five were negative roentgenographically. The basis on which these diagnoses were made is not very clear, as it is certainly not in accord with present conceptions to make a definite diagnosis of aortic aneurysm without the confirmation of X-ray studies. Finally, in the fourth group were placed those cases in which the diagnosis of aortic

formed and the process finally becomes more or less stabilized. This point of stabilization is not reached until at least a fairly large size has been attained and there would no longer be a possibility of confusion with pure aortitis. The changes which might occur in an uncomplicated aortitis are slight in comparison, consisting at the most of a slight increase in the general caliber of the aorta, more especially at its root, incident to the relaxation of the aortic ring which commonly occurs as a part of the syphilitic process.

This difference in the progress of fusiform aneurysm and aortitis should be utilized by keeping under observation all cases of syphilitic aortitis which show evidence of dilatation until it has been determined whether or not the aortitis is complicated by aneurysm formation. This procedure would also detect aneurysms arising from a previously uncomplicated aortitis at a time when the prognosis is best, because the response to conservative treatment is relatively much better when the diagnosis is made early (23).

REVIEW OF CASE MATERIAL

At the University Hospital during the last five years there have been 77 cases in which a final diagnosis of aortic aneurysm was made. The total number of admissions during this period was 121,325, so that the percentage of occurrence rate was only 0.06 per cent, which is much lower than any reported during recent years. This low percentage is probably due chiefly to three factors: first, that the number of negroes, among whom aortic aneurysm occurs with comparative frequency, seen here is small, due chiefly to the northern location; second, that a large proportion of patients come from farming districts, where syphilitic infection is usually considered to be less common, and third, that large numbers of children and young adults, who rarely develop

aneurysm, are included in the total admission figures.

All but two of the 77 cases had clinical evidence of syphilis, so that those of syphilitic origin constituted 97 per cent of the total. This is a very high figure, higher than any previously reported, and illustrates very well the predominance of syphilis as the cause of aortic aneurysm. Both of those in whom no evidence of syphilis could be discovered were females. The proportion of syphilitics who also had an aortic aneurysm was found, however, to be much lower than would be expected from the percentages given by Lamb (9), (25 per cent of syphilitics develop aortitis, and 30 per cent of these develop aneurysm), which seem to be lower than those generally accepted. It was determined by actual count that, excluding repeat examinations, the number of positive Kahn reactions during the year 1930 was 3.8 per cent of the total number of admissions during that year, so that for the five-year period it is estimated that there were 4,510 cases of syphilis, of which only 75, or 1.6 per cent, had an aortic aneurysm. The large number of children and young adults with congenital or acquired syphilis probably accounts to some extent for this rather unexpected result.

There were 68 males and 9 females in this series, giving a ratio of 7.5 males to one female. This is a higher sex ratio than usual. The age incidence was not unusual: ten in the third decade, twenty-six in the fourth, twenty-four in the fifth, fifteen in the sixth, and two in the seventh decade of life. The youngest patient was 31 and the oldest 72 years of age.

Classified according to location, there were 71 aneurysms of the arch and ascending portions, four of the abdominal aorta, and only two of the descending thoracic aorta below the arch.

Postmortem examinations were done in only 15 of these cases. They confirmed the



Fig 3, Case 3 Complete atelectasis of left chest from the pressure of an aneurysm of the descending aorta

Fig 4, Case 4 Aortitis and primary bronchial carcinoma Aneurysm of descending aorta not visible

Roentgenographic examination showed complete obscuration of the left lung and mediastinum, without any displacement or retraction of the mediastinum. Because of the lack of mediastinal displacement the findings were thought to indicate a tumor of the left lung or pleura. The patient was too ill for further roentgen study. Bronchoscopy showed paralysis of both vocal cords, and a large mass bulging into the trachea from the left and below. Bronchoscopy was repeated two days later to obtain a biopsy specimen, and the patient died a few hours later from the general effects of the operation. The final clinical diagnosis was mediastinal mass and neoplasm of the left lung. Postmortem examination showed a large sacular aneurysm of the lower part of the descending arch and the upper part of the descending thoracic aorta, which completely compressed the left main bronchus. The left lung was atelectatic and showed diffuse

fibrosis. There was marked erosion of the third to seventh thoracic vertebræ. In addition, there was a mediastinal abscess which extended up into the neck along the fascia, and probably originated from pressure supuration of the left bronchial nodes.

This case is interesting in that the atelectasis was masked by the failure of the mediastinum to be displaced to the affected side, as usually occurs, and the obscuration was therefore attributed to a neoplasm. It seems, however, retrospectively, that the positive Kahn and the long duration of the pain should have been hints in the right direction.

Case 4 (No. 156,807). A male, aged 38, a negro laborer, complained of pain in the feet and legs of two months' duration. There was a history of recent gonorrhea and a positive Wassermann reaction. Examination was negative, although gonorrheal spurs of the os calcis were diagnosed. Three

aneurysm had not been made by either clinical or roentgen study, but in which aortic aneurysm was found at autopsy. Four cases, or 5.2 per cent, constituted this classification. Two of them were early cases of dissecting aneurysm which were nearly microscopic in extent. The other two will be described later (Cases 3 and 4).

This analysis indicates that the roentgen study is not only necessary to make a definite diagnosis in clinically suspicious cases, but that it is also the means of discovering a large number of cases (nearly 30 per cent) in which the existence of an aortic aneurysm had not previously been even considered.

The following cases have been selected with the purpose of illustrating both the usual types of aneurysm, and the difficulties which may occur in diagnosis.

CASE REPORTS

Case 1 (No. 155,277). A male, aged 62, complained of dyspnea, palpitation, and attacks of chest pain, of six months' duration, and occurring chiefly on exertion. The physical examination showed unequal pupils and slightly increased retrosternal dullness. The Wassermann reaction was 4 plus, and a provisional clinical diagnosis of aortic insufficiency was made. The roentgen study showed marked widening of the ascending and arch portions of the aorta, and a report of probable diffuse aneurysm was made. In view of this finding the clinical diagnosis was changed to aortic aneurysm and the patient was discharged on potassium iodide and mercury rubs.

This is a good example of the diffuse (or dilatation) aneurysm which, while it cannot be distinguished with certainty from uncomplicated aortitis, should be classed as aneurysm because of the extent to which the dilatation has progressed, and also because of the progressive enlargement which occurs until a stabilizing point is reached.

Case 2 (No. 169,551). A female, aged

68, complained of attacks of coughing and dyspnea, and loss of weight. Dyspnea on exertion had been present for fifteen years. The symptoms showed marked increase in intensity about one year before admission, and a dull, boring pain appeared in the epigastrium. The sputum was profuse but not bloody. No tubercle bacilli were found. Examination showed many râles in the chest and no increase in substernal dullness. The Wassermann was 4 plus. At the conclusion of the outpatient examination the case was provisionally considered to be one of pulmonary tuberculosis and bronchiectasis, but the roentgen examination showed a large aneurysm of the aortic arch, with displacement of the esophagus to the right and dilatation above and below the arch. The diagnosis was changed to aortic aneurysm and slight symptomatic relief was obtained by ephedrine and atropin.

This case illustrates the close resemblance which cases of aortic aneurysm may have clinically to pulmonary tuberculosis. The cough, sputum, and dyspnea are all the result of pressure on and irritation of the trachea and larger bronchi. In many cases of this kind intermittent small hemorrhages of the respiratory tract are present, thus increasing the probability of tuberculosis being diagnosed.

Case 3 (No. 244,370). A female, aged 45, complained of dyspnea, loss of weight, pain in the left chest, and aphonia. The pain had first appeared about twelve years before admission, and was constant, dull, and boring in quality. The voice had been lost two years before, and a hundred pounds in weight had been lost in the period of two years. Examination showed marked dyspnea and sluggish pupils. There was complete flatness of the entire left chest on percussion. The Kahn reaction was 4 plus. The provisional diagnosis was chronic myocarditis, with question of pleural fluid or tumor of the left chest.



Fig 3, Case 3. Complete atelectasis of left chest from the pressure of an aneurysm of the descending aorta.



Fig. 4, Case 4. Aortitis and primary bronchial carcinoma. Aneurysm of descending aorta not visible.

Roentgenographic examination showed complete obscuration of the left lung and mediastinum, without any displacement or retraction of the mediastinum. Because of the lack of mediastinal displacement the findings were thought to indicate a tumor of the left lung or pleura. The patient was too ill for further roentgen study. Bronchoscopy showed paralysis of both vocal cords, and a large mass bulging into the trachea from the left and below. Bronchoscopy was repeated two days later to obtain a biopsy specimen, and the patient died a few hours later from the general effects of the operation. The final clinical diagnosis was mediastinal mass and neoplasm of the left lung. Postmortem examination showed a large sacular aneurysm of the lower part of the descending arch and the upper part of the descending thoracic aorta, which completely compressed the left main bronchus. The left lung was atelectatic and showed diffuse

fibrosis. There was marked erosion of the third to seventh thoracic vertebræ. In addition, there was a mediastinal abscess which extended up into the neck along the fascia, and probably originated from pressure suppuration of the left bronchial nodes.

This case is interesting in that the atelectasis was masked by the failure of the mediastinum to be displaced to the affected side, as usually occurs, and the obscuration was therefore attributed to a neoplasm. It seems, however, retrospectively, that the positive Kalin and the long duration of the pain should have been hints in the right direction.

Case 4 (No. 156,807). A male, aged 38, a negro laborer, complained of pain in the feet and legs of two months' duration. There was a history of recent gonorrhea and a positive Wassermann reaction. Examination was negative, although gonorrheal spurs of the os calcis were diagnosed. Three



Fig. 5, Case 4. Appearance of chest one month later. Spread of carcinoma clearly shown.



Fig. 6, Case 4. Lateral view showing scalloping of anterior surfaces of two vertebrae from the pressure of an aneurysm of the descending thoracic aorta just above the diaphragm (arrow).

weeks later the patient returned and there was then noted a slight increase in retrosternal dullness, and slight dullness at both apices. The liver was large and hard. X-ray examination at this time, November 26, 1926, showed what was thought to be a diffuse aneurysm of the arch, with enlargement to the right. A change in contour of the anterior surfaces of the lower thoracic vertebrae was noted, but was not thought to be due to aneurysmal pressure. The clinical diagnosis at this time was syphilis of the aorta, with aneurysm, and syphilis of the liver.

The patient returned again on December 26, 1926, as an emergency case, with greatly increased symptoms. The liver had become very large; dyspnea was marked, and the neck veins were distended. The retrosternal dullness was much increased. X-ray examination at this time showed a great change

in the chest condition. The shadow which had projected to the right and was thought to be an aneurysm was much larger, and in addition there were opacities in the right lower lung and in both hila. These were thought to be evidence of metastatic malignancy in the lung. The esophagus was examined and found to be pressed forward by a mass in the lower mediastinum. The patient died soon after (January 11, 1927), the final diagnosis being syphilis, diffuse aneurysm of the ascending aorta and arch, and probable metastatic malignancy in liver and lungs.

The postmortem examination revealed, however, a primary carcinoma of the right main bronchus infiltrating the right lung, with metastases to the liver, and an aneurysm of the lower part of the descending thoracic aorta, with erosion of the lower thoracic vertebrae.

This is an unusual and difficult case, because both a primary lung carcinoma and an aneurysm were present. The whole aorta was moderately dilated from syphilitic aortitis and the shadow of the lung tumor had a very smooth border, so that it was mistaken for an aneurysm. This very unusual smoothness of the infiltrating border was no doubt the real cause of the mistaken diagnosis which was made, although the border also had a quite remarkable continuity with the aortic shadow. The erosion of the vertebrae seen in the lateral views, and the displacement forward of the esophagus, were highly suggestive of aneurysm in this region.

SUMMARY AND CONCLUSIONS

1. Comparative clinical and autopsy statistics indicate that many cases of aortic aneurysm are not diagnosed during life.
2. Sacculated aneurysms, while the most common, are not the only type of aortic aneurysm, and the roentgen diagnosis should not be made contingent on finding local sacculations.
3. All cases of syphilitic aortitis with dilatation should be kept under observation until it has been determined by the progress of the lesion whether or not the aortitis is complicated by aneurysm formation.
4. Squaring of the aortic arch is characteristic of syphilitic aortitis.
5. A study of 77 cases of aortic aneurysm occurring during a five-year period demonstrated the percentage of occurrence rate to be 0.06 per cent, that the proportion of syphilitics with aortic aneurysm was 1.6 per cent, and that of the total number of aneurysms 97 per cent were of syphilitic origin.
6. The roentgen examination discovers a large number of cases of aortic aneurysm (nearly 30 per cent of this series) which produce no clinical signs or symptoms of their presence.

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Chronic nephritis, the result of X-radiation, has been produced experimentally and observed clinically. Warthin noted the presence of large deposits of lime salts in the tubules of the kidneys, and Rolleston has suggested that this may have arisen from the mobilization of calcium from irradiated bones. If this be true, the damage to an organ, such as the kidney, may occur without local irradiation.

Impaired development of the progeny of rats produced by irradiation may be transmitted, according to Mendelian laws, through many generations. Irradiation of a woman's

pelvis in early pregnancy may cause the death of the fetus, retarded development of the offspring, or defects such as subnormal mentality or even microcephaly. There may thus be danger in the application of X-rays in the diagnosis of pregnancy. Irradiation for the production of temporary sterility is strongly condemned.

The possible stimulation of the growth of malignant cells, claimed by Sampson Handley and others, is considered, together with Rolleston's conclusion that the stimulating effect of radiation on malignant growths cannot be regarded as established.

J. G. STEPHENS, M.B., D.M.R.E.

THE RELATIONS OF THE ANTRUM AND CAP TO THE GALL BLADDER; GASTRIC AND DUODENAL PERISTALSIS AS FACTORS IN EMPTYING THE GALL BLADDER¹

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AFTER a controversy covering several years in regard to the emptying of the gall bladder, certain facts are now generally accepted, while others are still in dispute.

Accepted Facts.—The gall bladder empties through the cystic duct into the common duct, thence into the duodenum.

The Heisterian valves do not furnish serious obstruction to the passage of bile in either direction.

There is a sphincter at the outlet of the common duct, the sphincter of Oddi, the function of which is to interpose a moderate barrier to the continuous passage of bile into the duodenum, thus allowing the gall bladder to fill. When the action of the sphincter is destroyed by inserting a cannula or by other means, the gall bladder does not fill. When the gall bladder is absent in animals or is occluded or removed by surgery in man, the secretory pressure overcomes the sphincter, the resistance of which is very low or absent under these conditions, and bile passes continuously into the duodenum.

There would be no pressure in the biliary system if it were not for secretory pressure. The secretion of bile is more or less continuous but is more active during gastric digestion. The secretory pressure of the bile is equalized by the removal of the fluid element of the bile by the gall bladder so that the pressure of the bile is below the threshold of the sphincter of Oddi when it is intact.

Bile passes into the duodenum intermit-

tently, by spurts, during the presence of food in the stomach and in small amounts occasionally during coughing, deep respiration, straining, etc. Immediately upon taking food, the pressure in the gall bladder is raised, and in a short time the gall-bladder bile (black bile) passes by spurts into the duodenum.

The function of the gall bladder is to receive, store, and concentrate the bile, to act as an equalizer of pressure in the bile duct system, and to deliver the bile periodically during early digestion into the duodenum. It does not normally empty in appreciable quantities when the stomach is empty.

Points in Controversy.—There is considerable controversy over the rôle of the following factors in emptying the gall bladder: Muscular development of the gall bladder and the efficiency and nature of its contraction; elastic recoil; respiration; engorgement of the liver; dilution and interchange of bile in the gall bladder; variations in intra-abdominal pressure; influence of the nerve supply on the gall bladder and reciprocal action with the sphincter of Oddi; a gall-bladder hormone (cholecystokinin of Ivy and Oldberg), and intestinal peristalsis.

Subjects Discussed in This Article.—There has been little or no discussion in the literature on the relation of the gall bladder to the antrum and cap, of the variations in the position of the gall bladder when the stomach is full and when it is empty, and of the relation of the antrum and cap to the gall bladder during peristalsis with a liquid meal and with a solid meal. Too little attention has been paid to the alterations in shape the gall bladder undergoes at the time of

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gastric peristalsis, and to the mechanical relations of the antrum and cap to the gall bladder at that time. The object of this paper is to demonstrate these relations and to

Without secretory pressure there would be no pressure in the entire tract. To determine secretory pressure, it is necessary to exclude the gall bladder, as absorption of the fluids

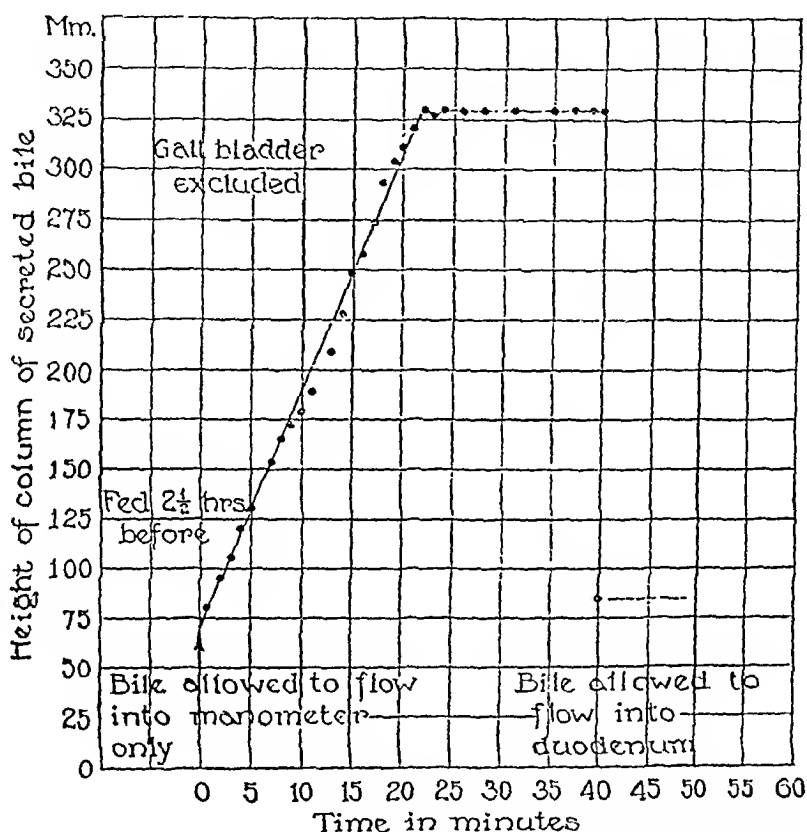


Fig. 1. The maximum secretion pressure of bile and its rate of formation in the presence of a pressure obstacle. The dots record the actual observations on an animal. It will be seen that the rate of secretion was unaffected by the increasing pressure obstacle.²

explain their rôle in emptying the gall bladder.

We would like to present the following short review concerning secretory pressure and pressure in the common bile duct and gall bladder, taken largely from McMaster and Elman (40).

SECRETORY PRESSURE

Bile is secreted more or less continuously, but more profusely during gastric digestion.

by the gall bladder occurs rapidly: in dogs, it has been found by various observers to be from 200 to 320 mm. of bile when all outlets are excluded. The time necessary to reach this point is from 15 to 30 minutes. The rate of secretion does not vary until the maximum pressure is reached, when it stops at once.²

²The following graphs (Figs. 1, 2, and 3) are taken from a reprint, "On the Expulsion of Bile by the Gall Bladder, and a Reciprocal Relationship with the Sphincter Activity," by Philip D. McMaster, M.D., and Robert Elman, M.D.

From 60 to 70 mm. of pressure causes bile to enter the gall bladder in the anesthetized dog, and 100 mm. in the unanes-

in the common duct during the next four hours equaled that of a column of bile about 125 mm. in height. There were frequently

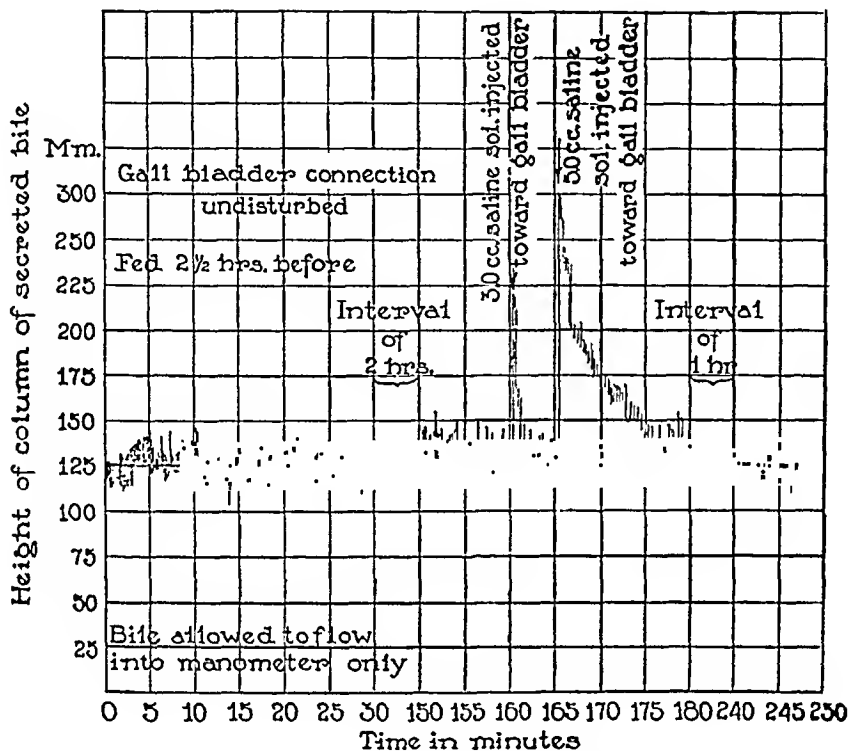


Fig. 2. The pressure developing during the first few hours of total biliary obstruction in an animal with the gall-bladder connections left undisturbed. Contrast with Figure 1. The manometer was connected with the common duct for over four hours.

thetized dog. The resistance to the passage of bile through the common duct sphincter in the normal animal fed from four to twelve hours previously is sufficient to support a column of bile from 100 to 120 mm. in height, and in the fasting animal from 250 to 300 mm. high. Immediately after taking food and again later during the process of digestion, the resistance is lowered to from 50 to 80 millimeters.

Quoting directly:

Two and one-half hours after feeding, the pressure that developed and was maintained

repeated rapid but slight, incidental fluctuations due to respiratory movements. Usually the column then rose or fell about 10 or 15 mm., occasionally, on a deep breath, 20 to 30 millimeters.

Immediately after the first swallows of food an abundant gush of far darker and more viscid bile suddenly flowed into the graduate, pointing to a discharge from the gall bladder.

Food was then offered to the animal and it was allowed to eat for $2\frac{1}{2}$ minutes, consuming in this time about 150 grams. Almost at once the bile column in the manometer, registering pressure changes within the gall blad-

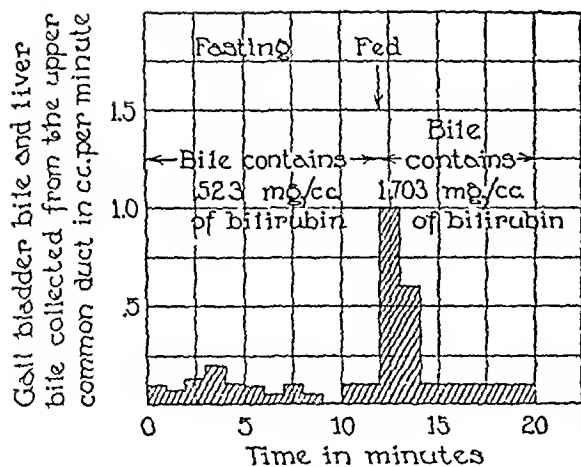


Fig 3. Food as a stimulus to the discharge of bile from the gall bladder. Bile was collected from the upper common duct draining both liver and gall bladder. The gall-bladder connections had been left undisturbed. When food was given, a large amount of viscid and highly pigmented bile was voided, practically at once. The differences in the amount and nature of the bile collected point to a discharge of bile from the gall bladder.

der, rose to over 200 mm, and it returned again slowly toward its previous level in the course of the next 8 minutes, reaching 115 mm. and there remaining. In the meantime food was removed. The column of bile in the manometer remained level until, 17 minutes later, food was again offered. Soon after eating, the bile rose above the 250 mm. level, overflowed the manometer, and the experiment was discontinued.

It is noteworthy that in these two experiments, and in all similar ones as well, there was no sudden gush of bile from the liver, the increase in bile secretion after feeding being very gradual.

In some of our experiments the column of bile in the tube connected with the gall bladder rose abruptly when the animal had taken not more than 150 gm. of food into a stomach previously empty. In several experiments the rhythmic recurrence of abrupt increases in pressure within the gall bladder, in the absence of any further ingestion of food, rules out the possibility that a generalized increase in intra-abdominal pressure was the direct cause of the phenomenon.

MUSCULAR DEVELOPMENT OF THE GALL BLADDER AND THE EFFICIENCY AND NATURE OF ITS CONTRACTIONS

The most obvious method of approach to the question of the emptying of the gall bladder is a study of its musculature.

Histological Considerations.—Gray's "Anatomy" (19) states:

The fibro-muscular coat, a thin but strong layer forming the framework of the sac, consists of dense fibrous tissue, which interlaces in all directions, and is mixed with plain muscular fibers, disposed chiefly in a longitudinal direction, a few running transversely.

Morris' "Anatomy" (39) calls the above-described layer, the fibromuscular layer, which consists of interlacing bundles of non-striated muscle and fibrous tissue not definitely arranged, the muscular bundles running longitudinally and obliquely.

Maximow's "Text-book of Histology" (44) states:

The Smooth Muscle Layer.—This does not form distinct layers as in the intestinal canal, but constitutes a very irregular network of longitudinal, transverse, and oblique fibers.

These descriptions do not give a very convincing picture of an actively contracting organ. The location of the gall bladder, partially buried in the liver and held there rigidly, is not conducive to free muscular contraction.

What evidence direct or indirect have we that the gall bladder empties by its own contractions?

Boyden (6) and others have reported tracings of serial cholecystograms showing a gradual decrease in the size of the gall-bladder shadow after the ingestion of egg yolk and cream, which they have attributed to typical gall-bladder contraction.³

³The accompanying illustration (Fig 4) is taken from the article, "Behavior of Human Gall Bladder during Fasting and in Response to Food," by E. A. Boyden (6). We believe that the changes in shape of the gall bladder shown in these tracings are due to direct external pressure and not to muscular contraction.

We do not believe that X-ray negatives showing the relation of the opaque antrum and cap to the gall bladder during these changes in shape, also negatives showing the peristalsis of the antrum and cap as a cause of these changes, have been adequately considered.

What record have we of direct observation of active peristalsis in the gall bladder in man or animals?

The nature of the changes in pressure in the gall bladder is, first, a sudden rise *immediately* upon the entrance of food into the stomach. This occurs too soon to be caused by increased secretion of the liver, which is gradual. In a short time there are rhythmic changes in the pressure in the gall bladder, followed by the intermittent passage of bile in spurts into the duodenum. If these changes were due to the intrinsic musculature of the gall bladder, there would have to be a tonic contraction followed by a peristaltic contraction.

Copher, Kodama, and Graham (11) state:

There has not been an indication of an actively effective contraction of the gall bladder, such as a peristaltic movement of the intestine or evacuation of the urinary bladder, in the thousands of cholecystograms that have been made by this department in man and animals. All of the changes in size and shape of the shadows are referable to an expansile organ.

Direct fluoroscopic examination of visualized gall bladders has uniformly failed to show any evidence of a peristaltic wave; and, more important still, direct electrical stimulation of

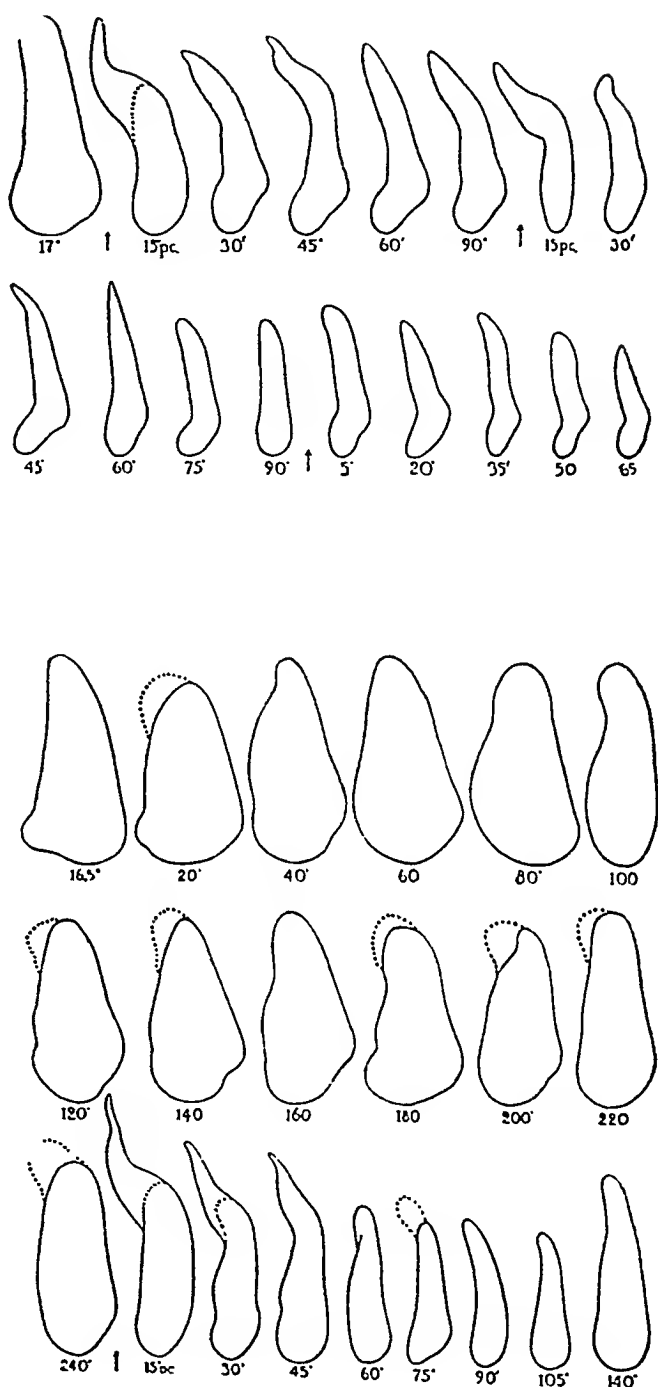


Fig. 4 (*Upper group*). Tracings of human cholecystograms ($\times \frac{1}{4}$) (Dr. L. O. Morgan), three weeks later than those shown below. First tracing (17'), gall bladder 17 hours after oral administration of iodine salts. Arrows indicate three intervals at which milk was taken. (*Lower group*) First two rows indicate changing shape of gall bladder during fasting. Dotted lines denote ampulla. Note contraction at 100'. Third row shows response to ingestion of half-pint of cream. Volume at 240', 2.85 cu. in.; at 60', 0.5 cu. in.; at 105', 0.35 cu. in. of bile.

the wall of the gall bladder of an anesthetized dog has never resulted in a contraction wave, although a similar stimulation of the intestine induced a violent peristaltic contraction. This agrees with a previous observation by Boyden and Whitaker.

tice gastric peristalsis during operation, but Moynihan (43), with his enormous surgical experience, states:

I have watched the gall bladder many hundreds of times during operation, and have

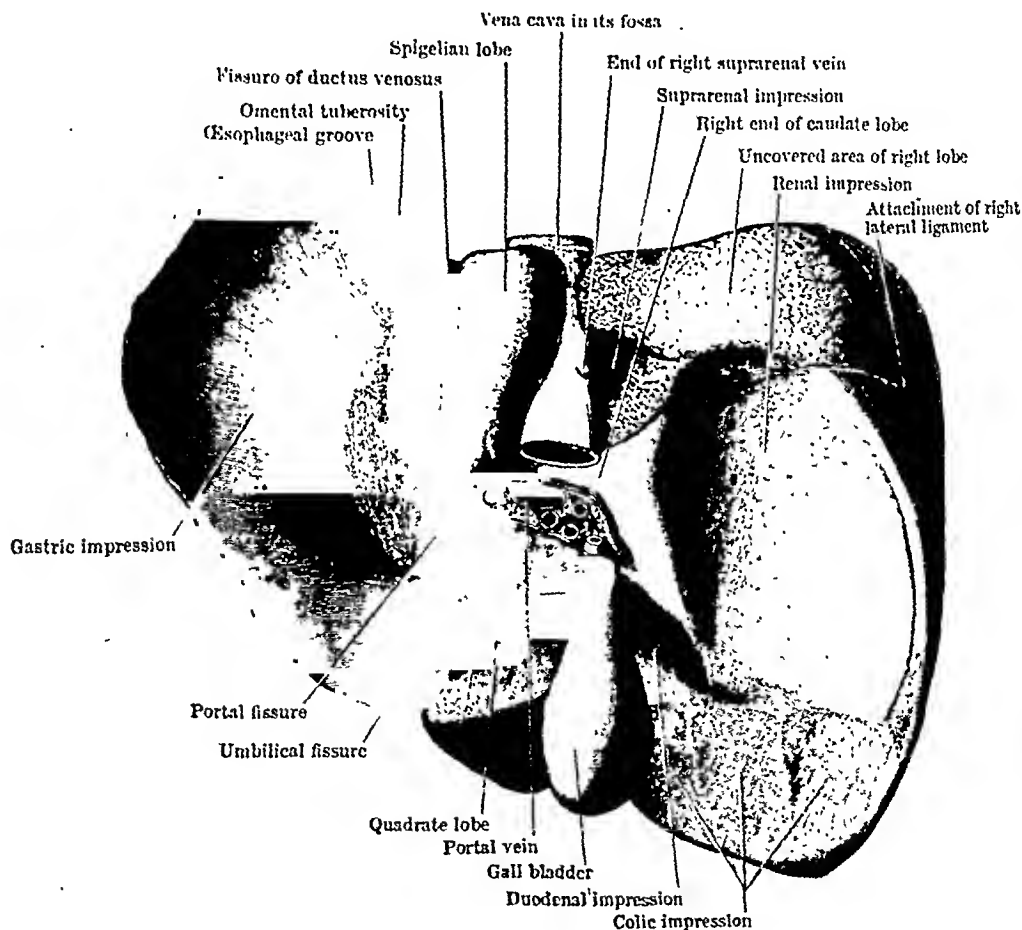


Fig. 5. Showing the relation of the antrum and cap to the gall bladder. During peristalsis, the antrum bulges out and presses the gall bladder against the liver. (From Cunningham's "Anatomy.")

We also see from the above quotation that electrical stimulation of the gall-bladder walls does not produce contraction of that organ as in other smooth muscle tissue.

It is not uncommon for the surgeon to no-

never seen anything approaching a tonic or peristaltic contraction. Very rarely one does see evidence of life. The fundus of the gall bladder or the wall near the fundus may show a movement that is best described as "wrinkling"; a part of the wall puckers after

pressure has for some time been put upon it in order to cause the bile to flow into the duodenum. But this action is slight and transient and incapable of producing any notable effects upon the contents.

ELASTIC RECOIL

Emerson and Whitaker (15) state:

With any sphincteric action of the intestinal musculature at the termination of the common duct prevented by an inlying cannula, the gall bladder shows no emptying for hours, but when the animal is fed it expels its contents in a normal manner.

This proves that the elasticity of the gall bladder does not empty its contents.

INFLUENCE OF THE NERVE SUPPLY ON THE GALL BLADDER

Denervating the gall bladder does not prevent its emptying if a meal is given. Whitaker (61) found, after a serious attempt to denervate the gall bladder, that egg yolk and cream would lead to gall-bladder evacuation.

Higgins and Mann (21) state:

Dogs in which the gall bladder has been entirely denervated, continued to respond to the fat diet in the normal way.

Whitaker and Boyden (57) report:

Further experimentation shows that the emptying of the gall bladder is not due primarily to reflex action, since the denervation of the organ does not inhibit its emptying after the ingestion of egg yolk.

Whitaker (61) also states that electrical stimulation of either vagus does not empty the gall bladder. He also says in the same article:

It does not seem justifiable to state that



Fig. 6. Tracings of X-ray films, showing the change in shape and position of the same gall bladder; (I) before eating, (II) after eating.

nerves have nothing to do with the action of the gall bladder, and yet, since the gall bladder functions normally after vagi and splanchnics are cut, and even after all the nerves in the lesser omentum are severed, it is safe to say at least that extrinsic nerves play no *essential* rôle in the mechanism for emptying the gall bladder.

RECIPROCAL RELATIONSHIP BETWEEN THE GALL BLADDER AND THE SPHINCTER OF ODDI

Careful work by Elman and McMaster (14) seems to establish a slightly fluctuating threshold pressure of the sphincter of Oddi of from 100 to 120 mm., in unanesthetized,

recently fed dogs before the flow started, and the flow always ceased at the 80 to 90 mm. level. These tests were taken between four and twelve hours after eating. Fasting twenty-four to seventy-two hours raised the

threshold from 200 to 250 mm. pressure. At the mere sight of food, the column of bile suddenly dropped, and the actual eating of food brought a further drop. In this connection, it is well to remember that hunger

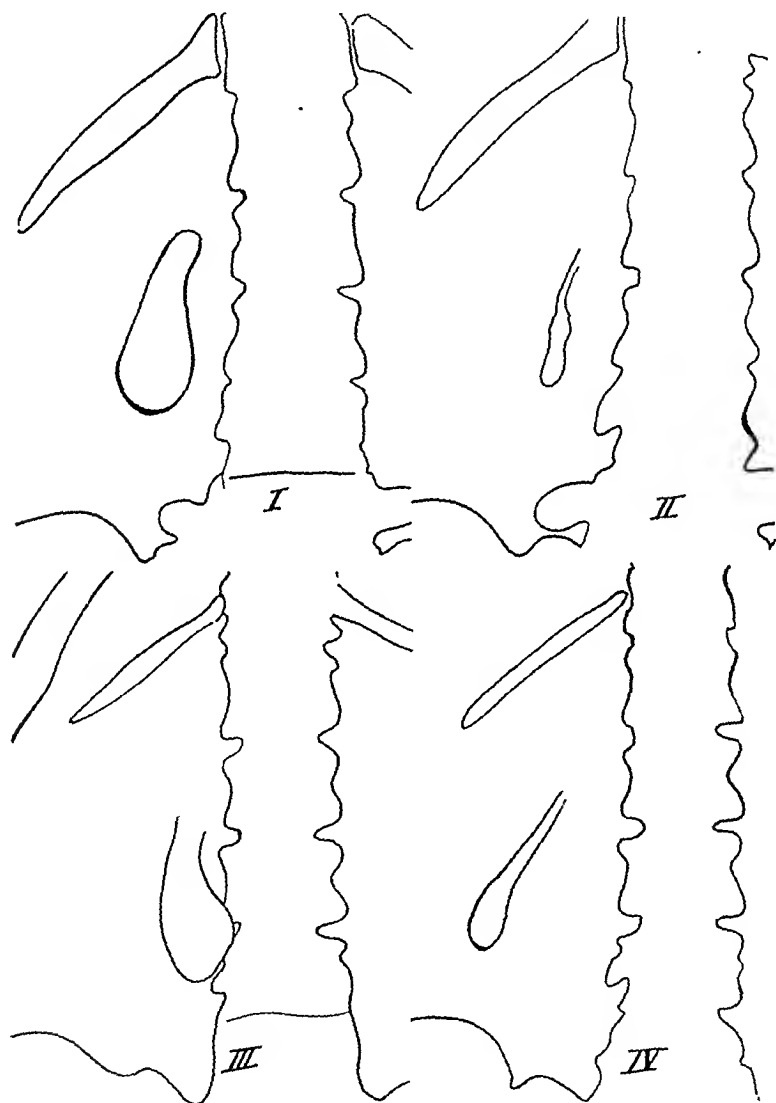


Fig. 7. Tracings of visualized gall bladders. Note that as they empty they are flattened laterally as though external pressure was exerted upon them, but not shortened. Most of the muscular fibers are longitudinal and their action should shorten the gall bladder. I and II are of one individual; III and IV of another individual. I and III are taken with the stomach empty; II and IV after a solid meal. Note the change in position and shape after eating.

pains are due to gastric peristalsis, also that the variations in the tonicity of the sphincter of Oddi, which is a thickened portion of the duodenal musculature, might well be a part

Also Lueth, Ivy, and Kloster (33) reported:

We have observed a number of dogs in

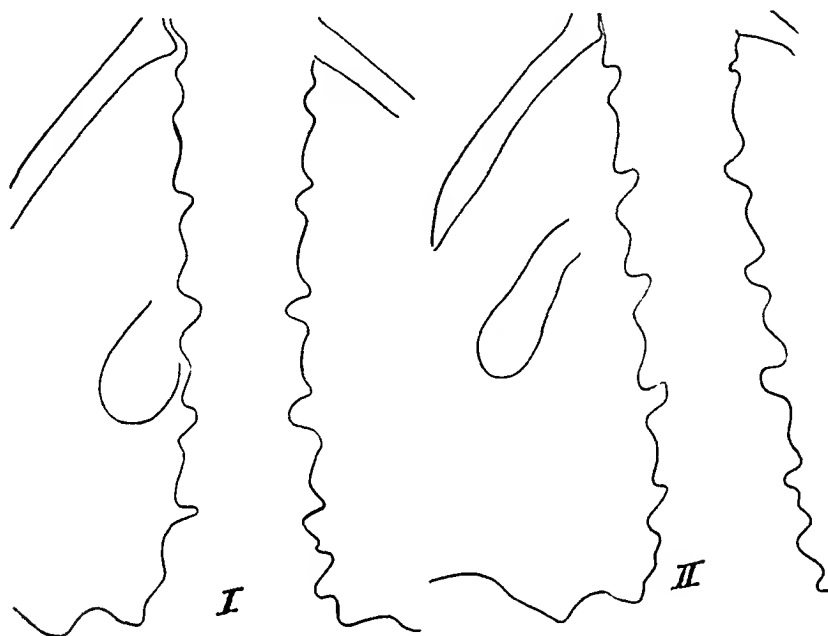


Fig. 8. Tracings of X-ray films of visualized gall bladder: (I) Gall bladder before eating; (II) gall bladder after eating. Note change in shape and position.

of the contraction and relaxation occurring during duodenal peristalsis and not due to a reciprocal action.

GALL-BLADDER HORMONE

Ivy and Oldberg (29) have been the main advocates of a gall-bladder emptying hormone, which they have called "cholecystokinin." It is derived from a highly purified secretin, produced by the action of hydrochloric acid on the mucosa of the duodenum and jejunum. The striking thing about their work is the fact that the pressure in the gall bladder remains up for a considerable time after one injection.

which the gall bladder would not relax completely after the injection of a single dose of "cholecystokinin," but would remain contracted for more than two hours.

A contraction of this type will not deliver an intermittent flow of bile by spurts. In other words, the pressure in the gall bladder is maintained at a higher level than normal for a long time.

In this connection we also quote the following from Starling (53):

The injection of 5 c.c. of a solution of secretin increased the secretion of bile by the liver from 27 drops in 15 minutes to 54 drops in 15 minutes.

Under Figure 4, in Ivy and Oldberg's (29) article, they state:

The tracing shows contraction of the gall

to evaluate the rôle that the hormone mechanism plays in gall-bladder evacuation, but it is quite certain that this mechanism is not the only one concerned.

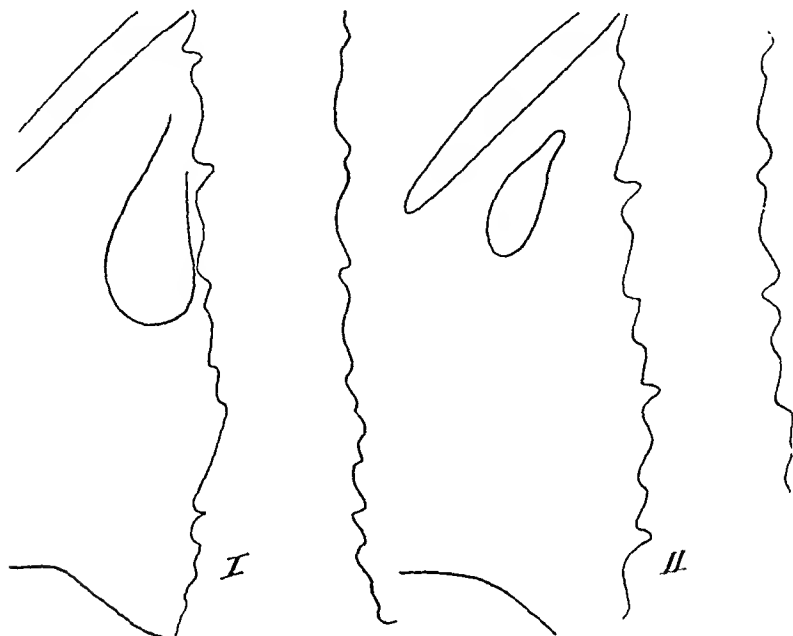


Fig. 9. Tracings of X-ray films of a visualized gall bladder in the sthenic type: (I) Shape and position of the gall bladder when the stomach is empty; (II) change in position of the gall bladder upward and outward following a solid meal.

bladder, with rhythmic contractions (approximately 3 per minute), caused by the injection into the duodenum of 50 c.c. of pancreatin-digested egg yolks and cream.

The rhythmic contractions were produced when food was injected into the duodenum.

Ivy's (27) final conclusions in April, 1930, are as follows:

Burget had found that a cholecystikinin solution will not only cause the gall bladder of the guinea pig to contract *but also the duodenum*. Kendall found that it would also cause the isolated intestine of the guinea pig to contract.

It is impossible with the evidence at hand

INTRAVENOUS INJECTIONS

According to Ivy and Oldberg (29):

Every agent we have injected which causes a fall in blood pressure has caused a contraction of the gall bladder.

Higgins and Wilhelmj (22) summarize the results of intravenous injection of fats by saying:

The results of these three methods of study are in agreement in that the gall bladders of cats and dogs do not empty when the emulsions of fat described are injected into the blood stream. Slight tonic changes which are noted are considered as insignificant and

wholly unrelated to the presence of the fat. Observations made on the gall bladders of cats, following the oral administration of the

after having decreased in size. In our experience, this seldom occurs except in pathologic gall bladders.



Fig. 10. Tracing of X-ray films of same individual: (I) visualized normal gall bladder; stomach empty; (II) visualized gall bladder after eating a solid meal; stomach visualized. Note the change in shape and position of the gall bladder after eating, and the relation of the antrum and cap to the gall bladder.

emulsions described, show conclusively that the vesicle empties in response to these foods in the gastro-intestinal tract, and, accordingly, the conclusions are manifest that contraction of the gall bladder is related to gastro-intestinal activity either of a hormone or of a nervous excitation.

THE INTRODUCTION OF AIR, FOOD, AND DRUGS INTO THE DUODENUM

The gall bladder has been shown to empty in response to substances injected into the duodenum, such as air, food, egg yolk, $MgSO_4$, etc. ($MgSO_4$ exerts the most powerful evacuative force on the gall bladder of any inorganic reagent, according to Boyden and Birch, 5), any one of which could easily cause peristalsis of the duodenum and antrum.

DILUTION OF GALL-BLADDER BILE

In X-ray examinations this is indicated by an enlargement of the gall-bladder shadow

THE RELATIONS OF THE ANTRUM AND CAP AS FACTORS IN EMPTYING THE GALL BLADDER

We have seen repeatedly that the whole problem of emptying the gall bladder is closely associated with the taking of food, and that gall-bladder bile is emptied into the duodenum early in gastric digestion intermittently by spurts.

We believe that a careful study of the relation of the antrum and cap, when filled and during peristalsis, to the gall bladder, and a study of the effects of various foods on gastric peristalsis, and the emptying time of the stomach, will aid in explaining the emptying of the gall bladder.

ANATOMICAL RELATIONS

We are quoting from Gray and Cunningham to call attention to the exact anatomic relationship of the antrum, pylorus, and duodenum to the gall bladder and the liver during the fasting stage and after a meal.

From Gray's "Anatomy" (20):

(THE STOMACH) *The Pyloric Orifice*.—Its position varies with the movements of the stomach. When the stomach is empty the pylorus is situated just to the right of the median line of the body, on a level with the upper

direction of the first portion depends upon the amount of distention of the stomach and therefore upon the position of the pylorus. When the stomach is empty and the pylorus situated at the right of the upper border of

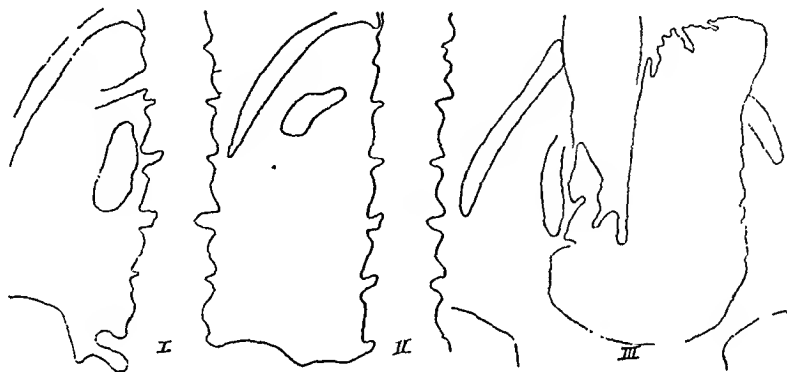


Fig. 11. Tracings of X-ray films of the same person: (I) visualized gall bladder; stomach empty; (II) visualized gall bladder; stomach filled with solid meal. Note change in shape and position after eating a solid meal. (III) Visualized gall bladder; stomach filled with barium and buttermilk. Note that the gall bladder lies nearer the midline and lower with the liquid meal than with the solid meal.

border of the first lumbar vertebra. As the stomach becomes distended the pylorus moves to the right, and in a fully distended stomach may be situated two or three inches to the right of the median line.

Alterations in Position.—When the stomach is distended its surfaces, which are flattened when the organ is empty, become convex. The greater curvature is elevated and carried forward, so that the anterior surface is turned more or less upward and the posterior surface downward, and the stomach brought well against the anterior wall of the abdomen.

When the stomach becomes distended the change in the position of the pylorus is very considerable; it is shifted to the right, some two or three inches from the median line, and lies under cover of the liver, near the neck of the gall bladder.

(THE SMALL INTESTINE) *The Duodenum*.—In the adult the course of the duodenum is as follows: Commencing at the pylorus the

the first lumbar vertebra, it is nearly horizontal and transverse, but where the stomach is distended, in consequence of the alteration of the position of the pylorus to the right the proximal end of the duodenum also becomes altered in position, while the distal end remains fixed and the direction of this portion of the bowel is now antero-posterior. Whether directed transversely or antero-posteriorly, it reaches the under surface of the liver, where it takes a sharp curve and descends along the right side of the vertebral column, for a variable distance, generally to the body of the fourth lumbar vertebra.

The first or superior portion is very variable in length, but is usually estimated as being about two inches. Beginning at the pylorus, it ends at the neck of the gall bladder. It is the most movable of the four portions. It is almost completely covered by peritoneum derived from the two layers of the lesser omentum, but a small part of its posterior sur-

face near the neck of the gall bladder and the inferior vena cava is uncovered. It is in such close relation with the gall bladder that it is usually found to be stained by bile after death, especially on its anterior surface. It is

In the gradual passage of the stomach from the empty to the distended condition we may recognize three stages.

First stage: This commences with an enlargement of the fundus, and is followed by an



Fig. 12. Tracings of X-ray films: (I) visualized gall bladder; stomach empty; (II) the same gall bladder partially empty after a solid meal. Note (1) crescentic indentation in cap due to a pathologic gall bladder, (2) that the antrum projects well beyond the original location of the gall bladder during active peristalsis.

in relation above and in front with the quadrate lobe of the liver and the gall bladder; behind with the gastro-duodenal artery, the common bile duct, and the vena porta, and below with the head of the pancreas.

From Cunningham's "Anatomy" (12):

(THE DIGESTIVE SYSTEM) *The Stomach.*—With distention there comes a general enlargement of the various diameters, an elongation of the whole organ, with a consequent passage of its pyloric portion to the right beneath the liver, the development of the antrum pylori, and an inclination of its axis from behind downwards and forwards, without any rotation.

expansion of the whole cardiac portion, which passes upwards and also to the left towards the diaphragm, displacing the coils of the transverse colon, which lie here when the stomach is empty. The pyloric portion for three or four inches still remains contracted and cylindrical. In this condition the stomach is frequently found after death.

Second stage: As distention goes on the lesser curvature opens out, the pyloric portion (with the exception of its last inch) expands, but its junction with the cardiac portion usually remains distinct, until distention is almost complete.

Third stage: A further general expansion of the whole stomach takes place; the diameters of both cardiac and pyloric portions, as

well as the length of the organ, are increased, and the great curvature presses forward against the anterior abdominal wall in front, where the restraining influence of the ribs is absent. The pyloric end for about one inch

distention it is carried to the right beneath the quadrate lobe, and its terminal part is there directed backwards in order to reach the duodenum. Even in this condition its last inch remains comparatively undistended.

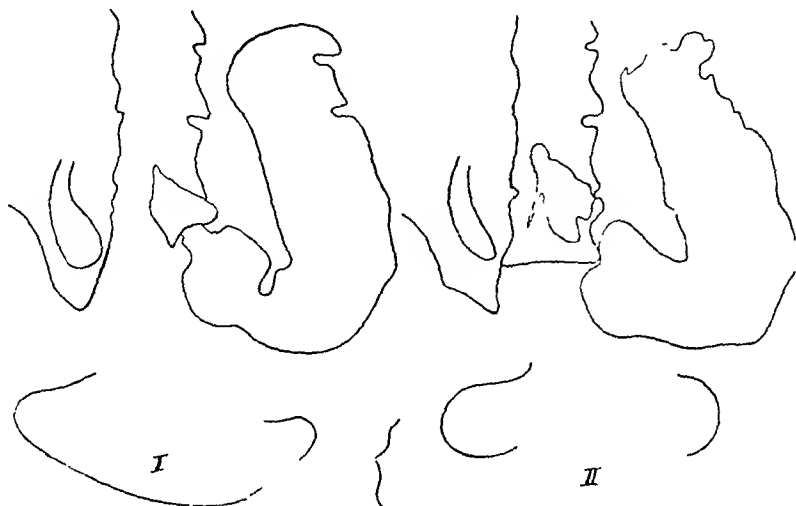


Fig. 13. Tracing of a case of marked ptosis of the stomach. Gall bladder and stomach both visualized. The gall bladder lies between the crest of the ilium and the vertebral column; the antrum and cap lie low and to the left. Such altered relations prevent the contact of the antrum and cap during peristalsis.

(2.5 cm.) from the pylorus remains narrow (constituting the pyloric canal of Jonnesco), but to the left of this it bulges forward, forming the antrum pylori, which is most distinct at the great curvature. By the increase of the organ in length the antrum is carried a considerable distance to the right beneath the liver—even farther than the pylorus itself—so that the terminal part of the stomach is bent backwards and to the left, in order to reach the pylorus, which latter very rarely passes more than one and a half or two inches to the right of its normal position, namely, in the empty condition, within half an inch (12 mm.) of the middle line.

The narrow or pyloric end, when the stomach is empty, is contracted and cylindrical, and runs transversely to the right, lying as a rule beneath the left lobe of the liver. . . . During

The Duodenum.—When the stomach is distended, the first inch of the duodenum—which is movable on account of its peritoneal covering—is carried to the right with the pylorus, and thus brought into line with the second or terminal half, which is always directed backwards. Hence the whole of the first portion of the duodenum is directed backwards when the stomach is full.

Above the colon, it is in contact with the narrow end of the gall bladder and below it with the coils of the small intestine.

Figure 5, taken from Cunningham's "Anatomy," shows the relation of the antrum and cap to the gall bladder; during peristalsis, the antrum bulges out and presses the gall bladder against the liver.

X-RAY OBSERVATIONS

Attention has been called repeatedly to the rise in pressure immediately upon the taking of food. This occurs entirely too

to eat a regular meal of solid food (meat, potatoes, bread, butter, and salad if desired), and to return in one-half to one hour for another film. We have noted as a general thing, particularly if the gall bladder be

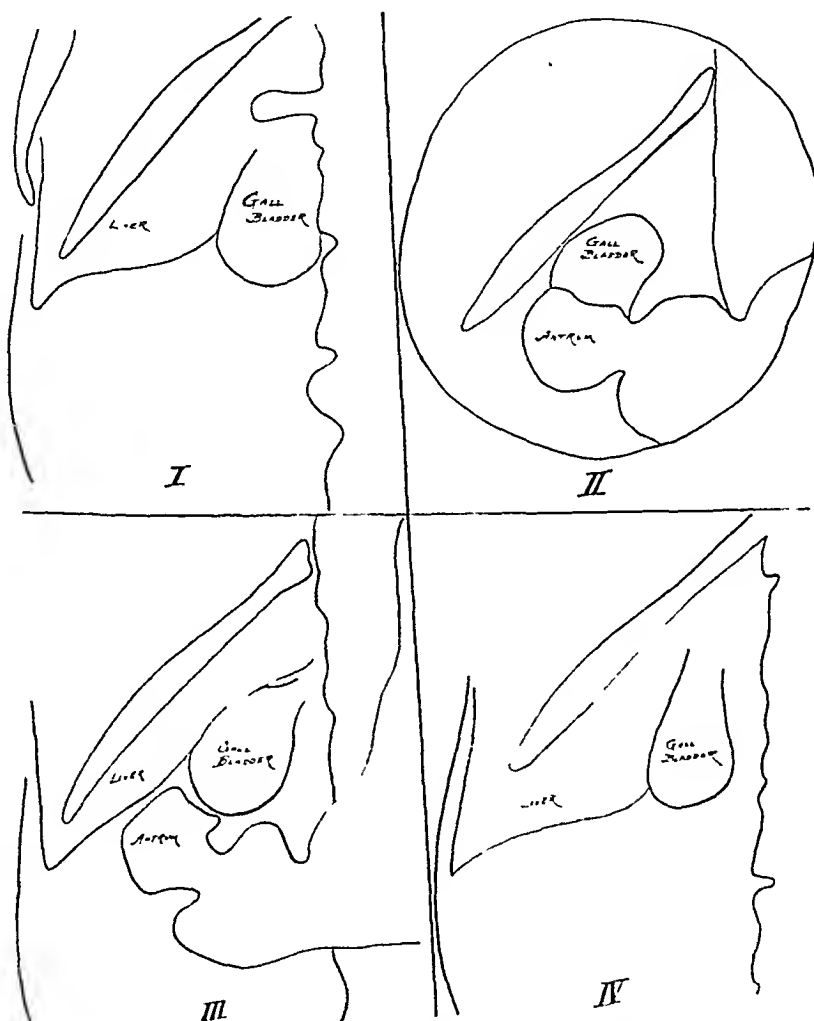


Fig. 14. Four tracings of X-ray films of same case: (I) visualized gall bladder; stomach empty; (II) change in position of gall bladder after eating; (III) note that the antrum during peristalsis does not press the gall bladder against the liver; (IV) marked retention of the dye for 24 hours.

soon to be the result of secretory pressure.

It has been our custom over a period of years to take a film six hours after the intravenous injection of sodium tetraiodophenolphthalein. We then instruct the patient

normal, that it was shifted to the right and upwards from 1 to 2 inches, and that the gall bladder generally was flattened or had a curved indentation on the side adjacent to the stomach. This corresponds with the

well as the length of the organ, are increased, and the great curvature presses forward against the anterior abdominal wall in front, where the restraining influence of the ribs is absent. The pyloric end for about one inch

distention it is carried to the right beneath the quadrate lobe, and its terminal part is there directed backwards in order to reach the duodenum. Even in this condition its last inch remains comparatively undistended.

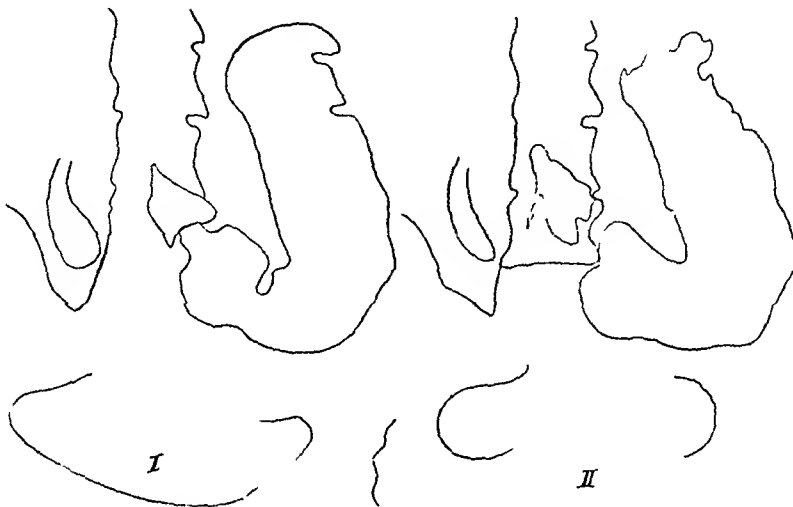


Fig. 13. Tracing of a case of marked ptosis of the stomach. Gall bladder and stomach both visualized. The gall bladder lies between the crest of the ilium and the vertebral column; the antrum and cap lie low and to the left. Such altered relations prevent the contact of the antrum and cap during peristalsis.

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The Duodenum.—When the stomach is distended, the first inch of the duodenum—which is movable on account of its peritoneal covering—is carried to the right with the pylorus, and thus brought into line with the second or terminal half, which is always directed backwards. Hence the whole of the first portion of the duodenum is directed backwards when the stomach is full.

Above the colon, it is in contact with the narrow end of the gall bladder and below it with the coils of the small intestine.

Figure 5, taken from Cunningham's "Anatomy," shows the relation of the antrum and cap to the gall bladder; during peristalsis, the antrum bulges out and presses the gall bladder against the liver.

But entirely independent of this respiratory fluctuation was the larger range of fluctuation in the level, induced by the activity of the gall bladder itself. These larger fluctuations were variable in their extent and ranged from 20 to 40 mm. of bile at more or less varying intervals, thus suggesting a variable frequency in the rate of contraction of the muscle tunic. These intervals between successive contractions ranged from twenty to thirty seconds, the actual period of contraction being only a few seconds' duration.

GASTRIC PERISTALSIS

We quote the following from Alvarez (2) on gastric peristalsis:

In the human stomach, waves appear about once in twenty seconds.

On the lesser curvature the amplitude is very small, and in the antrum it is large.

The peculiar form of the contraction curve exhibited by the muscle in the pyloric antrum was observed even in the frog.

We have seen that distention of smooth muscle generally causes it to contract more actively.

Quoting from Templeton and Johnson (36) on hunger contractions:

Simultaneous tracings, by the ordinary manometer method, from three different portions of the stomach show hunger motility to be peristaltic. . . . Unlike the contractions in the upper portion of the stomach, that seen nearest the pylorus is not preceded by a rise in tone. The contraction is sudden and sharp.

Rehlfuss (49), quoting Carlson, states:

Hunger contractions are powerful peristaltic contractions which arise at, or near, the cardiac sphincter and sweep downward over the entire stomach, so that during a typical hunger period the stomach exhibits movements which have been described by roentgenographers after the bismuth meal has been given. . . . It is generally believed that any irritant

reaching the duodenum may produce spasm at or near the pylorus.

Quoting from Birch and Boyden (3):

Faradic Stimulation of Stomach (Spontaneous Rhythm of Gall Bladder).—When previously working with cats in which the gall bladder had been filled with iodized oil, we had occasionally noted spontaneous changes in the tonus of the gall bladder during fasting.

Curiously enough, the stomach of this cat was visualized by its natural content of air, so that when films were developed it was seen that the tonus changes in the gall bladder paralleled a series of peristaltic waves that were passing over the cardiac end of the stomach.

Reflex Contraction of Gall Bladder.—Evidence that the spontaneous rhythm of the gall bladder just described was induced by peristalsis of the stomach, is indicated by the following experiment. When the pars pylorica of the stomach of the cat shown in Plate 2 was stimulated with a strong induction current, the gall bladder immediately contracted, forcing the iodized oil farther into the upper lobe than occurred under the influence of spontaneous contractions.

This experimental stimulation of the stomach seems to afford conclusive proof that vigorous contraction of the stomach induces reflex contraction of the gall bladder.

In a human case already described, the patient reported intense, subjective hunger pangs at the time that X-rays were recording pronounced emptying of the gall bladder. Previous to this Boldyreff had shown that in dogs, periodic hunger contractions of the stomach are accompanied by spurts of bile from the common duct.

Summary by Birch and Boyden.—(1) Faradic stimulation of the pars pylorica of the stomach induces sudden contraction of the relaxed gall bladder and ejection of bile into the cystic duct. (2) Hunger contractions of the stomach occur synchronously with rhythmic contractions of the gall bladder and probably account for the periodic emptying of the gall bladder during fasting.

change in position of the antrum and cap when the stomach is distended, as described by Gray and Cunningham.

If the tension is from 100 to 120 mm. in the gall bladder when the stomach is empty,

additional pressure would be exerted on the gall bladder to cause it to empty by spurts.

According to Starling (53), the normal pressure in the duodenum is about 150 mm. of water and the pyloric intragastric pres-



Fig. 15. Tracings of X-ray films of same individual: (I) visualized stomach and cap (note long narrow antrum); (II) visualized gall bladder; stomach empty; (III) visualized gall bladder after solid meal; (IV) visualized gall bladder, 24 hours after intravenous injection of dye. Note the association of a long narrow antrum and a gall bladder that does not empty in 24 hours. Nature apparently is trying to protect an inflamed gall bladder from the peristaltic action of the antrum.

it seems obvious that if sufficient pressure is exerted on the gall bladder by the filled stomach, antrum, and cap to shift it to the right and up against the mass of the liver which holds it rigidly, it would raise the pressure within the gall bladder *at once* upon eating. If, in addition, vigorous peristalsis of the antrum occurs, particularly if the stomach is filled with solid food, sufficient

sure 100 mm. during relaxation and from 200 to 300 mm. during an intensive wave.

The rate of the intermittent increase of pressure given by Ivy, Boyden, Higgins and Mann, and others corresponds with that of gastric peristalsis.

Higgins and Mann (22) state the following:

Fig. 16. Negatives taken of the same stomach during different stages of peristalsis. Note the bulging of the antrum and its marked shifting to the right during active peristalsis.

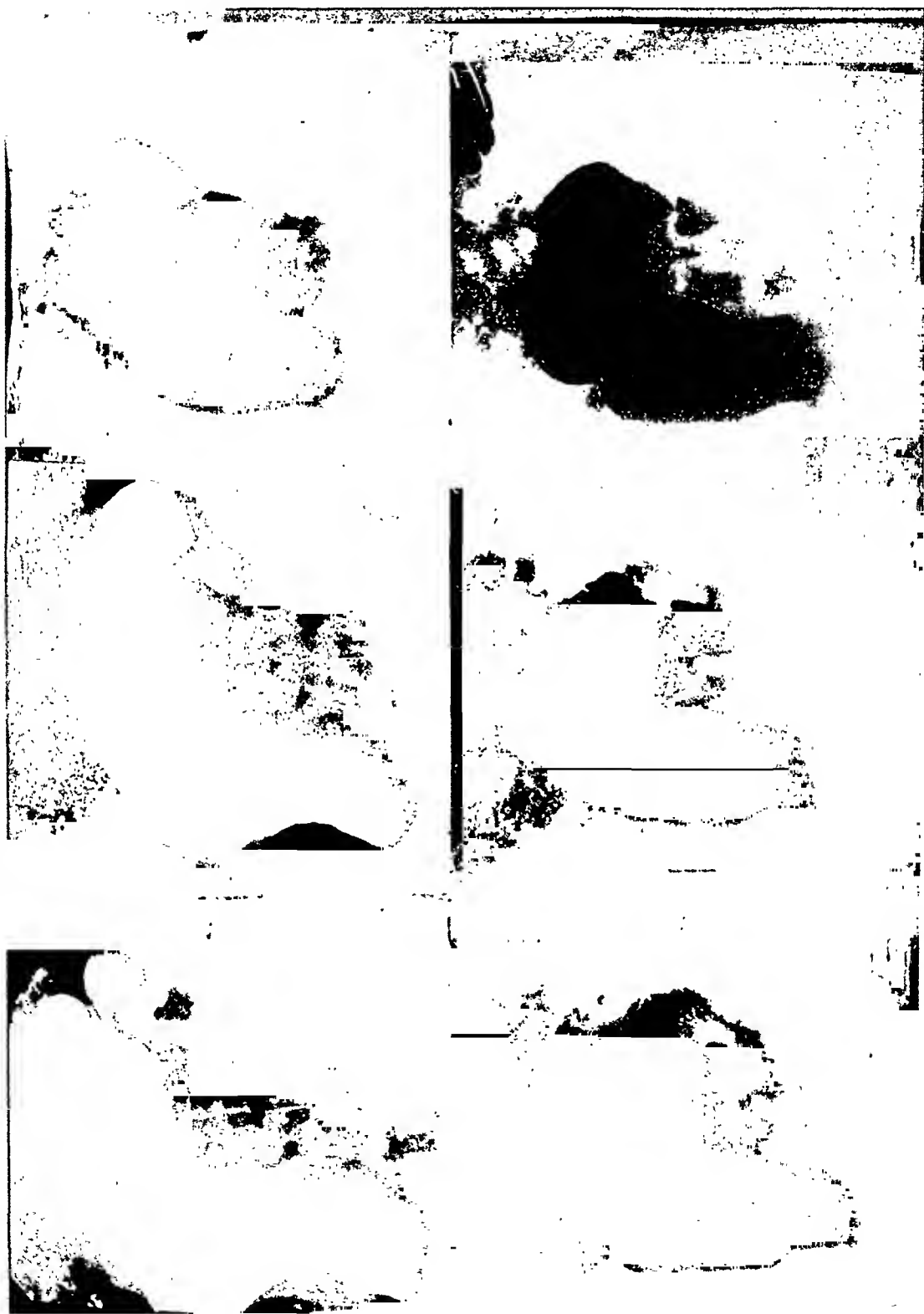


TABLE 1.—OBSERVATIONS ON FOUR SUBJECTS WITH SIX DIFFERENT MEALS*
(From *Wilson, Dickson, and Singleton*)

Subject	Thick porridge 240 c.c.			100 gm. dates and bread 40 gm.			140 gm. ground lean meat			120 gm. fat bacon 5 egg yolks			240 c.c. 32 per cent cream			240 c.c. 32 per cent cream + 0.5 gm. hydrochloric acid		
	Percentage out in			Percentage out in			Percentage out in			Percentage out in			Percentage out in			Percentage out in		
	First Leav- ing	1½ Hrs.	4½ Hrs.	First Leav- ing	1½ Hrs.	4½ Hrs.	First Leav- ing	1½ Hrs.	4½ Hrs.	First Leav- ing	1½ Hrs.	4½ Hrs.	First Leav- ing	1½ Hrs.	4½ Hrs.	First Leav- ing	1½ Hrs.	4½ Hrs.
A.....	1	85	100	3	50	75	3	50	75	15	20	30	2	40	50	2	40	50
B.....	2	70	100	4	50	60	4	50	60	31	10	50	2	40	50	1	30	40
C.....	3	95	...	12	70	100	7	40	80	...	...	...	2	50	65	...	...	...
D.....	4	75	90	...	...	...	...	...	...	12	10	30	1	75	80	1	75	90

*With each meal the first column shows the time in minutes after the commencement of ingestion that barium was first seen in the duodenum. The other three columns give the percentage of the meal which has left the stomach in one and one-half, three, and four and one-half hours, respectively. Each meal totals 240 c.c. and contains 40 gm. of barium sulphate.

We do not believe that reflex contraction of the gall bladder is the correct explanation, because repeated observers (including Boyden himself) state that the gall bladder will empty when food is taken, even after the gall bladder has been completely denervated.

We are including a table by Wilson, Dickson, and Singleton (60) in regard to the emptying time of the stomach.

It is interesting to note how early carbohydrates leave the stomach and how slowly proteins and fats leave the stomach. The virtue of the fat meal in emptying the gall bladder can be explained by the length of time fats stay in the stomach, if we are right in our contention that food in the stomach raises the gall-bladder pressure nearly to the threshold of the sphincter of Oddi by direct pressure of the antrum and cap, and that gastric and duodenal peristalsis furnish the additional pressure to empty the gall bladder periodically by spurts.

The changes in shape and size of the gall bladder are synchronous with gastric peristalsis. The change in the shape of the normal gall bladder corresponds with the shape of the antrum pressing against it causing it to collapse, because the pressure in the filled stomach is greater than in the normal gall bladder.

The pathologic gall bladder, because of the pathology present, is either not compressible or the pressure required to collapse it is decidedly increased. Consequently, a crescentic or flattened indentation of the antrum or cap generally indicates a pathologic gall bladder.

In a previous article by the authors (45), the following is stated: "Indirect pressure signs, principally irregular duodenal caps, or a flattened crescentic indentation on the antrum or cap, were seen in about three-fourths of the cases diagnosed as pathologic gall bladders and in about the same percentage that were operated upon."



Lack of motility of the pylorus, antrum, and cap also prevents the intimate relations of the antrum and cap to the gall bladder. Marked variations from the medium habitus, increase in weight, and pregnancy also disturb this relation and predispose to gall-bladder disease.

PREGNANCY

Mann and Higgins (38) state:

The degree of emptying in the pregnant female, however, depends on the stage of pregnancy. In animals observed in the early stages of pregnancy, slight emptying had occurred four hours after the taking of the "fat meal," although in no instance, even in early pregnancy, was the degree of emptying comparable with that of the non-pregnant animal. From about the time of the middle of pregnancy to term, there was no evidence of the emptying of the gall bladder.

A comparison of two gall bladders, one of a non-pregnant animal, which emptied, and the other of a pregnant animal, which did not empty, raises questions with regard to the so-called tests of function of the gall bladder. The gall bladder of the non-pregnant animal appeared normal grossly, and emptied and filled normally. The gall bladder of the pregnant animal appeared normal grossly but did not empty normally. Its contents showed the characteristics of stasis. Also, shortly after removal of the contents of the uterus, the gall bladder of the pregnant animal again responds normally in every respect. It is apparent that activity of the gall bladder may be influenced by factors outside the biliary tract and that the organ should neither be judged diseased nor be removed because of its response to these extraneous factors, which may be physiologic.

GALL-BLADDER PATHOLOGY AND DISORDERS OF GASTRIC PERISTALSIS

Most of the manifestations of gall-bladder pathology are associated with disorders of gastric peristalsis. The long, narrow,

rigid antrum, gastric retention, and disorders in gastric peristalsis have long been noted in gall-bladder diseases.

The occurrence of gallstone colic after heavy meals rich in fats probably is due to increased peristalsis putting extra pressure on the gall bladder. Nature produces vomiting to relieve this pressure and to protect the inflamed area. Washing of the stomach and withholding of food will relieve gallstone colic better than a hypodermic of morphine.

Birch and Boyden (63) state that faradic stimulation of the pylorus induces sudden contraction of the relaxed gall bladder and that "these observations confirm the existence of a reflex pathway extending from the splanchnic area to the gall bladder."

We believe such a reflex is unnecessary as the peristalsis of the antrum causes pressure on the gall bladder directly, sufficient to account for its emptying. Numerous investigators have demonstrated the emptying of the gall bladder by a meal when all nerves to the gall bladder have been removed. Consequently, we believe the best explanation of the emptying of the gall bladder is that it is due to the increased pressure of a filled stomach accompanied by gastric and duodenal peristalsis pushing the collapsible gall bladder against the under surface of the liver, thus emptying it by spurts early in gastric digestion, purely by mechanical means.⁴

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⁴Through the assistance of Dr. Otto S. Kretschmer, Director of our Pathological Department, we have determined that in the guinea pig and in the cat the gall bladder lies in the midline when the stomach is empty and in direct relation with the antrum and first portion of the duodenum; the empty stomach lies to the left of the midline; the gall bladder is shifted to the right and toward the head in the filled stomach. The gall bladder and stomach when injected with opaque medium definitely show this shift, also an intimate relation between the gall bladder and the antrum and cap, in the negatives taken in the posterior anterior position. In a previous article (43), in 1927, we advocated similar views in regard to the rôle of the antrum and cap in emptying the gall bladder.

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Lack of motility of the pylorus, antrum, and cap also prevents the intimate relations of the antrum and cap to the gall bladder. Marked variations from the medium habitus, increase in weight, and pregnancy also disturb this relation and predispose to gall-bladder disease.

PREGNANCY

Mann and Higgins (38) state:

The degree of emptying in the pregnant female, however, depends on the stage of pregnancy. In animals observed in the early stages of pregnancy, slight emptying had occurred four hours after the taking of the "fat meal," although in no instance, even in early pregnancy, was the degree of emptying comparable with that of the non-pregnant animal. From about the time of the middle of pregnancy to term, there was no evidence of the emptying of the gall bladder.

A comparison of two gall bladders, one of a non-pregnant animal, which emptied, and the other of a pregnant animal, which did not empty, raises questions with regard to the so-called tests of function of the gall bladder. The gall bladder of the non-pregnant animal appeared normal grossly, and emptied and filled normally. The gall bladder of the pregnant animal appeared normal grossly but did not empty normally. Its contents showed the characteristics of stasis. Also, shortly after removal of the contents of the uterus, the gall bladder of the pregnant animal again responds normally in every respect. It is apparent that activity of the gall bladder may be influenced by factors outside the biliary tract and that the organ should neither be judged diseased nor be removed because of its response to these extraneous factors, which may be physiologic.

GALL-BLADDER PATHOLOGY AND DISORDERS OF GASTRIC PERISTALSIS

Most of the manifestations of gall-bladder pathology are associated with disorders of gastric peristalsis. The long, narrow,

rigid antrum, gastric retention, and disorders in gastric peristalsis have long been noted in gall-bladder diseases.

The occurrence of gallstone colic after heavy meals rich in fats probably is due to increased peristalsis putting extra pressure on the gall bladder. Nature produces vomiting to relieve this pressure and to protect the inflamed area. Washing of the stomach and withholding of food will relieve gallstone colic better than a hypodermic of morphine.

Birch and Boyden (63) state that faradic stimulation of the pylorus induces sudden contraction of the relaxed gall bladder and that "these observations confirm the existence of a reflex pathway extending from the splanchnic area to the gall bladder."

We believe such a reflex is unnecessary as the peristalsis of the antrum causes pressure on the gall bladder directly, sufficient to account for its emptying. Numerous investigators have demonstrated the emptying of the gall bladder by a meal when all nerves to the gall bladder have been removed. Consequently, we believe the best explanation of the emptying of the gall bladder is that it is due to the increased pressure of a filled stomach accompanied by gastric and duodenal peristalsis pushing the collapsible gall bladder against the under surface of the liver, thus emptying it by spurts early in gastric digestion, purely by mechanical means.*

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*Through the kindness of Dr. Otto S. Kretschmer, Director of our Department, we have determined that in the guinea pig the gall bladder lies in the midline when the stomach is empty and in direct relation with the antrum and first portion of the duodenum; the empty stomach lies to the left of the midline; the gall bladder is shifted to the right and toward the head in the filled stomach. The gall bladder and stomach when injected with opaque medium definitely show this shift, also an intimate relation between the gall bladder and the antrum and cap, in the negatives taken in the posterior anterior position.

In a previous article (45), in 1927, we advocated similar views in regard to the rôle of the antrum and cap in emptying the gall bladder.

through the cystic duct never comes out through the cystic duct. I would like very much to know if the writers have paid any attention to these observations, which seem very far-fetched to me. I would also like to ask if they have had an opportunity to study some cases of partial gastrectomy and see what happens in those cases in which there is no pressure possible from the stomach or duodenum.

DR. A. C. SIEFERT (Oakland, Calif.): I have frequently seen the gall bladder filled with the contrast medium as long as forty-eight hours after injection or ingestion of tetraiodophenolphthalein, the patient taking fluid liberally but no solid food and, especially, no food containing fats. The stomach must have been well distended by copious intakes of fluid. Again, I have never seen the gall bladder empty when giving a meal or rather a drink of barium water, even in amounts sufficient to distend the stomach and the duodenal cap well. I, therefore, cannot accept the theory that has been set forth by the speaker.

A MEMBER: I had the privilege of working with the writer a short time in 1925, and some of the things that Dr. LeWald has suggested we did. We, after considerable search, found a patient who had had a gastrectomy, in whose case all the food left the stomach by the gastrotomy. In that individual the gall bladder emptied after a food that was rich in fat.

DR. NEWCOMER (closing): I realize that the idea seems rather novel. I wish to answer Dr. LeWald first. I have read carefully the articles by Sweet in which he claims that bile which has entered the gall bladder is absorbed into the circulation and does not pass through the cystic duct into the duodenum. Since the visualization of the gall bladder, Sweet's idea has been discarded by all, even Sweet himself. Vigorous peristalsis of an empty stomach,

even, will partially empty the gall bladder. In those cases of gastrectomy which I have seen, the gall bladder does not empty completely in the normal time. Imperfect emptying of the gall bladder can occur by interchange of bile due to secretory pressure. If I am right in the theory that normal emptying of the gall bladder is caused by the pressure of a filled stomach in active peristalsis, what happens when a gall bladder is filled with stones or does not fill at all? If nothing enters the gall bladder, the secretory pressure of the liver overcomes the sphincter of Oddi and the bile enters the duodenum as it is secreted. If the gall bladder fills and is not in proper contact with the antrum and cap, it may empty imperfectly for a time at least by the intermingling and dilution of freshly secreted bile. This is not the normal method, however.

In regard to the question as to why water in the stomach does not empty the gall bladder, I would say water passes through the empty stomach without producing peristalsis. The extent of peristalsis depends on solid food; that is why I emphasize solid food so much. On the slides, I showed you how much more the gall bladder was displaced by solid food in the stomach than by a liquid meal. It is well known that solid food stimulates vigorous peristalsis. After an intravenous dye test, you can give water indiscriminately with the stomach empty, without emptying the gall bladder. We allow patients whatever water they want; it goes right through without peristalsis. In regard to giving solid foods, to produce emptying of the gall bladder, we have been using the intravenous dye test for years, followed by a solid meal. The method of using cream and egg did not appeal to us—it is not a normal meal. We started in by giving solid food and we have found that the normal gall bladder empties after a normal meal of solid food. We always take a twenty-four-hour film, to determine if the gall bladder is entirely empty at this time.

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DISCUSSION

DR. THOMAS A. GROOVER (Washington, D. C.): I am sure we will all agree with the essayists that the gall bladder is a more or less movable sac which is subject to changes in shape and position by extrinsic pressure, including, of course, pressure from the stomach and duodenum. I am not so sure that all of us would be willing to accept, offhand at least, the interesting hypothesis advanced to the effect that the gall bladder is emptied by

the thrust of the stomach and duodenum against it. I think that some arguments could be advanced to the contrary. First, I am sure that all of us have observed, in the course of routine cholecystographic examinations, with the subject fasting, that at one time we would find the gall bladder large, then we would find it small, and then we would find it large again, which, of course, would argue against the mechanical factor as causing it to empty. The fact of the matter is that such a phenomenon as this is one that we rather like to see, because it probably has some diagnostic significance. I believe it is highly probable that if we made examinations at frequent intervals, we would observe it much more frequently than we do. In the second place, I do not believe that any one has ever been able to empty the gall bladder by external pressure or by manual manipulation. Third, it requires considerable pressure to empty a filled gall bladder when you have the belly opened and can grasp it in your fingers. Fourth, it is a well known fact that the taking of certain foods, particularly fats, will cause a rapid emptying of the gall bladder, whereas other foods, whether liquid or solid, have comparatively little effect. Fifth, I should think that it would be necessary to disprove the work of Ivy and Oldberg before accepting the mechanical factor. I wish to pay tribute to the novelty of the idea suggested by the essayists, that the mechanical factor plays such an important rôle in solving a much disputed question. Of course it may prove to be correct. I feel sure that there are many modifications of function and also much disease due to simple mechanical causes that we fail to recognize and appreciate. I have enjoyed the paper presented, as it opens up a new field for thought and investigation as to the explanation of gall-bladder emptying.

DR. L. T. LEWALD (New York): I wish to call attention to the theory of Dr. Sweet, who has written several papers on the formation of gallstones, stating that the gall-bladder secretion and bile in it is entirely removed by absorption. I have heard him make the statement that what goes into the gall bladder

plate and which with ordinary technics would not give a sharp image.

I have shown evidence of the importance this technic may have in the study of the structure of bone; I have called attention to the usefulness this technic may have in studying pulmonary structure and in craniology, but, laying aside all this, I wish now to present some considerations of a modification of this technic as applied to the study of the head.

It is well known that the radiographic image which results is the summation in the same plane of all the shadows arising in the various planes of the body traversed by the roentgen rays.

In craniology, and especially in the study of the base of the skull, the numerous shadows which are superimposed one on another produce an intricate network of lines which make the interpretation of the roentgenogram difficult in certain cases.

As a result of this, it would be most advantageous to have an image, so to speak, distinct from that of all the various planes and without the image of them being superimposed on that one of interest to us. In other words, it would be an advantage to do with X-rays what we do with the microscope; that is, to focus only one plane of the object.

If we could adopt with roentgen rays lenses and reflectors as we can with light rays, or if we could put only one plane in focus as with the microscope, the problem would be very simple; but since it is impossible to do this at present, it is necessary to try some other way.

Let us imagine that the photographic plate and the roentgen tube are united in a rigid system, capable of rotation around an axis, and which, while radiography is carried on, has a slight movement on its own axis. Any object which is in the axis of movement will produce a good image, while the others will be softened and blurred in the roentgenogram. We can imagine that in

the roentgenographic examination of the head, it can be made to slightly rotate on an axis which corresponds to the region which is of interest in the examination.

For many reasons I have followed this latter path and have constructed two types of apparatus, which, during an examination, cause rotation of the head on an axis which passes through the plane of the region under consideration. If we use this simple technic we will find another way to sharpen the roentgenogram.

As I have pointed out in the first part of this communication, the focus of the target is never a point but is always a surface, as a result of which the image of a plane of the cranium which is at a certain distance from the plate will never be sufficiently sharp.

Now let us go back to the technic of enlargement which permits us to obtain sharp images, even of regions which are distant from the plate. It is sufficient to use, instead of an ordinary X-ray tube in the apparatus for producing rotation, an autoprotecting tube, in the window of which there is screwed a disk with a little hole in it, which, in the case in point, should be of a diameter sufficient to give a sharp image but not an enlarged one, as the case may be, of 1 or 2 millimeters, which will permit us to shorten the time of exposure.

At the last Italian Congress of Radiology in Turin, I showed radiographs in which the various strata of the head were, so to speak, isolated.

With this technic we can explore almost separately the various levels of the base of the skull, and avoid—up to a certain point, at least—the superimposition of extraneous shadows.

These two procedures should be studied further and perfected, for there is no doubt but that they can render useful service in advancing the improvement of radiographic technic.

RADIOGRAPHY WITH GREAT ENLARGEMENT (MICRORADIOGRAPHY) AND A TECHNICAL METHOD FOR THE RADIOGRAPHIC DISSOCIATION OF THE SHADOW

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Prof. V. Maragliano, Director

Translation by E. T. LEDDY, M.D., Rochester, Minn.

I HAVE named "microradiografia," or "technic of radiography with great enlargement," that procedure which I have proposed by which to obtain radiographic images enlarged directly, a procedure which I described in 1928 and to which I have called attention in several publications and worked out under the guidance of my chief, Prof. V. Maragliano.

It is to be noted that many attempts have been made to enlarge ordinary roentgenograms by optical means (Piergrossi, Moreau), but this type of enlargement, because of the character of the image and the structure of the sensitive film, can not be carried beyond a certain point. There are also some commercial optical methods for enlarging the image on the fluorescent screen.

Attempts have also been made to produce rapid enlargements by moving the fluorescent screen to a greater distance (Krause and Kreuzfuchs) or by moving the photographic plate (Grödel and Wachter).

It is known that if we move the object away from the plate and bring it nearer to the source of radiation, we get an enlarged image which will be a sharp one if the rays emerge from a point, but practically, the focal spot of the X-ray tube is far from being a point, and is, in fact, an area of some size. So by moving the object away from the screen or plate we obtain, it is true, an enlarged image but a blurred one, due to the optical effect of penumbra.

If, however, we place between the object which we desire to enlarge and the target of the tube a very small window, the rays coming from the target will cross as a result of

this, and, following their rectilinear path to the photographic plate, will reproduce faithfully, enlarged on the image of the target, any object which is between the window and the sensitive plate.

This is the principle which I propose to apply in order to obtain directly enlarged images in radiography.

The apparatus for producing the enlargement is extremely simple. It is sufficient to arrange a series of lead disks with small holes in them, varying in size from 1 or 2 millimeters to 1 or $\frac{1}{2}$ decimillimeter. These lead disks are screwed into the window of an autoprotecting tube.

The technic consists in placing the object, an enlarged image of which is desired, more or less distant from the film according to the degree of enlargement desired; the greater the distance between the object and the plate the greater will be the enlargement resulting, but the diameter of the window will be smaller. By this method we obtain directly an enlarged image with roentgen rays.

I have shown in previous papers the differences between photographic enlargement of an ordinary roentgenogram and that obtained directly, especially since the roentgenogram obtained in this way can also be enlarged by optical means.

The procedure I am discussing here permits one to obtain enlarged roentgenograms directly; permits one, even when the purpose is not to obtain enlargement, to produce roentgenograms with good detail, a fact which is of much importance in studying those regions of the body which are of necessity distant from the photographic

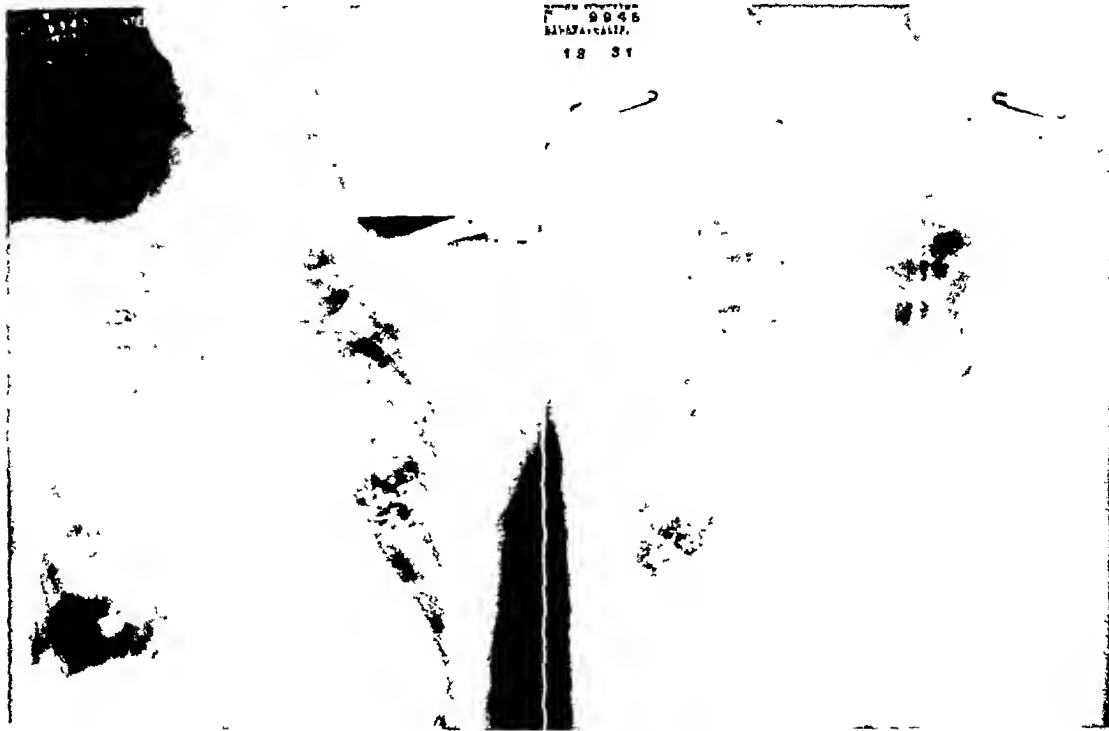


Fig. 3. Case 3.

Fig. 4. Case 3, showing condition when patient was much improved over that shown in Figure 3.

big-chested man, anxious expression, slight exophthalmos, dyspnea, very slight cyanosis. The heart was considerably enlarged to palpation and percussion; friction rub felt at apex. Moist râles throughout the chest. Cough produced some bloody sputum. Abdominal tenderness in right upper quadrant and epigastrium.

Outcome.—Symptoms continued unabated. The patient developed pulmonary edema and died fifteen days after onset of illness.

Autopsy.—The left upper lobe of the lung was edematous. The outer third of the lower lobe was congested, red, and contained no air. The vessels throughout the lung were extremely congested and the pulmonary veins were engorged. Bronchi were filled with fluid, but not injected, or red. Lower lobe and part of the middle and upper lobes on the right were dark red in

color. Blood flowed readily from cut surface. Marked engorgement of pulmonary veins and branches. Small infarcts in the outer surface of the right lower lobe. Pericardial sac contained no fluid but pericardial adhesions were present throughout. Heart twice normal size. On outer aspect of left ventricle is a triangular area of necrotic muscle with a rupture, the rupture being sealed by adherent pericardium. Heart was dilated, its walls thin, its valves all negative. Right coronary artery sclerotic, but patent. The left coronary artery entered the soft necrotic muscle of the left ventricle, but no thrombus could be demonstrated.

In going over the findings with Dr. Sturdivant, the pathologist, and trying to correlate them with the radiographs, he stated that the shadows seen on the radiographs were undoubtedly due to engorgement of the large pulmonary vessels—that

CASE REPORTS AND NEW DEVICES

PASSIVE CONGESTION OF THE LUNGS IN THE PRESENCE OF CORONARY SCLEROSIS

By JOHN FRYE CHAPMAN, M.D.

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The following two cases are presented because of their striking radiographic appearance and their similarity in clinical history, findings, and outcome, and because the knowledge of the cause of the first led to the correct diagnosis of the second. The third case is presented because of the similar appearance though the outcome was recovery.

Case 1. The patient, A. H. L., a male, aged 50 years, complained of continuous

severe precordial pain, two weeks in duration between date of onset and death.

Present Illness.—On the morning of November 15, 1928, he began to have acute severe pain in the right upper quadrant of the abdomen. By noon the pain had shifted to the precordium, left shoulder and arm. This pain continued and required opiates from time to time for relief. Three days later he became quite intensely jaundiced and remained so for a week, after which the jaundice disappeared.

Past History.—No previous serious illnesses. An attack of acute indigestion two years before had been readily cured by diet and rest.

Physical Examination.—Large-framed,



Fig. 1. Case 1.



Fig. 2. Case 2.

and treatment have always resulted in fairly prompt recovery.

Physical Examination.—Well developed but not very well nourished man of 68 years. Head and neck not remarkable, except that there is slight cyanosis. (*Chest*): Coarse moist râles throughout both lungs. (*Heart*): Enlargement to percussion not noted in findings. Pulse irregular in rate and quality. Blood pressure 152/80. No murmurs noted. (*Abdomen*): Liver edge at costal margin. Ileac vessels palpable through abdominal wall. Question of nodular mass in left hypochondrium. (*Extremities*): Marked sclerosis of peripheral arteries.

X-ray Examination.—Colon negative for evidence of obstruction. Abdomen negative for radiographic evidence of gallstones or urinary calculi. (*Chest*): Shadows extending out into both lung fields very suggestive of congestion in large vessels secondary to coronary sclerosis and advanced myocarditis. Enlargement of heart.

Sputum.—Scanty fresh blood-tinged, chiefly mucus, with a few leukocytes and endothelial cells and Gram-positive diplococci and streptococci. No tubercle bacilli.

Feces—Negative. (*Urine*): specific gravity, 1.016. Trace of albumin. Many hyaline and granular casts, some leukocytes.

Blood Count.—Red blood corpuscles, 4,370,000; white blood corpuscles, 14,500; polymorphonuclears, 82 per cent; lymphocytes (large), 6 per cent; lymphocytes (small), 12 per cent; no abnormal cells; hemoglobin, 83 per cent.

Admitted February 23, 1931; dismissed March 14, 1931; much improved.

The similarity of appearance of the radiographs in this case and the previous ones is striking. I particularly wish to call attention to the heavy centrally placed shadows, the comparatively clear periphery of the lungs, and especially the clear lung bases, which in the usual passive congestion of de-

compensation in heart disease one would expect to find clouded. Figure 4 is of Case 3, just before the patient left the hospital and when he was feeling much improved. One notices that the central shadows are still visible, though less extensive, less dense, and more clear-cut. The three cases present an unusual type of passive congestion, and one which I believe always indicates the presence of severe coronary disease and left ventricle degeneration.

TUBERCULOSIS OF THE URETER, WITH TWO CASE REPORTS

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Hospital

Involvement of the ureter is a frequent complication of tuberculosis of the kidneys, the bacilli being carried down by the urine.



Fig 1 Case 1. Films made in March, 1926. Shortening and stiffening of the right ureter. Left ureter normal.

there was not enough congestion of the lung parenchyma to cause them. The films were taken about five days after the onset of the illness and much congestion of the lungs may have taken place afterward.

Case 2. The patient, W. S. D., male, aged 69 years, complained of precordial pain and shortness of breath.

Present Illness.—Two weeks before examination he was putting up a water drain at the eaves of his home (an unusual exertion for him), when he fell from the ladder, but seemingly without serious injury. A short time after this he began to have a severe heavy pain in the middle of the chest, which radiated first to the right shoulder and then shifted to the left shoulder and down the left arm. The left arm felt weak, numb, and was very painful. There was also pain in the epigastrium, which became a prominent symptom. Dyspnea and orthopnea were constant and extreme.

Past History.—He had had the usual diseases of childhood, no rheumatic fever, no syphilis. Eight years previously he had had empyema on the right side.

Physical Examination.—Head negative. Neck, pulsating carotids. Chest, numerous coarse râles at both bases, more marked anteriorly. Impaired resonance at both bases anteriorly and posteriorly. Heart, no precordial thrills. Moderate enlargement of left ventricle. Weak systolic murmur at both aortic and mitral areas: arrhythmia. Abdomen negative, except for enlarged and slightly tender liver. Otherwise physical findings were not remarkable. Electrocardiogram showed myocarditis, with insufficiency.

The patient died one week after entering the hospital and at autopsy the findings of importance were as noted below.

Autopsy (Pleural cavities).—The left contained about a liter of clear straw-colored fluid; the right showed marked adhesions,

particularly at the base. (*Lungs*): The pulmonary veins were considerably distended. Thorough sectioning revealed no tumor in either lung and the parenchyma showed very little congestion. The right lung showed no evidence of old abscess though it was markedly adherent to the diaphragm and there were a few small bronchiectases. In general, however, the lungs were in quite good condition. *Heart* weighed 560 grams, very much enlarged: all valves negative. There was a large thin plaque of fibrinous mural thrombus one inch in diameter over the inside of the left ventricle near the tip and the myocardium here was friable. Elsewhere in all parts of the myocardium of the left ventricle there was very marked degeneration and fibrosis. The wall was not hypertrophied, being only about one centimeter in thickness. Both coronary arteries showed marked sclerosis in all branches, but especially in the descending branch of the left coronary. There was practically complete occlusion of this branch at a point 3 or 4 cm. from its origin, but there were no coronary thrombi. There were no other findings in the chest.

An attempt to correlate the autopsy findings with the radiographs leads to the conclusion that the shadows extending out from the lung roots were undoubtedly due to the engorged large pulmonary vessels, the lung parenchyma having been found very little congested.

Case 3. The patient, B. T., male, aged 68 years, complained of (1) pain in left side of abdomen radiating downward from left lumbar region, paroxysmal in character, duration one week; (2) vomiting.

Past History.—Attacks of a similar nature have been fairly common in the past. He has known for a long time that he has serious heart disease; in fact, in previous attacks he has nearly lost his life, but rest

eral months. Nocturia, and burning pain upon urination.

Cystoscopy showed hyperemic, ulcerative bladder mucosa.

Pyelograms showed normal kidney pelvis on both sides. The right ureter, however, was straight and shortened.

Guinea-pig inoculation from the right side was positive for tuberculosis.

Upon removal of the kidney, the specimen was of twice normal size, the cortex destroyed by cystic degeneration, and filled with purulent material. A smear of this pus showed numerous tubercle bacilli. There was no involvement of the kidney pelvis.

CONCLUSIONS

Tuberculous involvement of the ureter is a frequent complication of tuberculosis of the kidney.

It may be present before involvement of the kidney pelvis can be demonstrated.

A diagnostic sign is straightening and shortening of the involved ureter, which can be determined by use of an opaque catheter.

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A CASE OF ADHESIONS OF THE SMALL BOWEL

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and

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Lesions of the small bowel are rarely suspected and, as a result, are seldom looked for. The following case is of interest in this respect.

S. W., a little girl six years of age, had been complaining of pain in the abdomen, associated with nausea, for six months prior to this examination. On two occasions she

vomited. For about ten days before we saw the patient, the pain had been getting worse although at no time was it sharp. Recently she had been awakened at about 3 A.M. with pain, relieved by pressure over the abdomen.

The child had had scarlatina and varicella in infancy. She had a perverted appetite, eating glass, chalk, paper and such things.

One of us (L. J. G.) was called to see the child on the morning following one of her nocturnal attacks. The parents thought that she had appendicitis, but the surgeon found that the abdomen was soft and that there was no tenderness and no elevation of temperature and, therefore, he did not think she had appendicitis but that she might have a partial obstruction resulting from the various foreign substances she ate. After several more attacks an X-ray study was ordered, for the purpose of ruling out the presence of foreign bodies in the gastrointestinal tract.

On February 5, 1931, a roentgen-ray study of the gastro-intestinal tract was started by one of us (A. R. B.). A preliminary film of the abdomen showed no evidence of opaque foreign bodies. The chest was normal. The stomach and duodenum were also normal as to size, shape, motility, and mobility.

At one hour there was 80 per cent of the barium mixture in the stomach, the remainder being scattered throughout the small bowel. A loop of bowel was located at about the middle of the abdomen, towards the left side, which was dilated. There was a marked to-and-fro movement. This appearance was also noted at later examinations at two, three, and four hours. At three and a half hours the stomach was empty. At twenty-four hours the colon was completely filled, with no barium in the small bowel. The appendix was filled, fairly mobile, and tender, the tenderness being located directly over the appendix and chang-



Fig. 2. Case 1. Film made in January, 1929. Shortening and stiffening of both ureters. Multiple calcified shadows in both kidneys.



Fig. 3. Case 2. Straightening and shortening of the right ureter.

Ulceration or caseous infiltration follows, resulting in a shortened, thick-walled, firm, widened ureter, with a ragged ulcerative lining. This shortening with stiffening can be seen on a roentgenogram by means of opaque catheters.

This was first observed by Dourmashkin, who found it in 84.6 per cent of his series of 13 cases of unilateral tuberculosis. This may be the first X-ray evidence of tuberculosis of the kidney, as was observed in the following two cases:

Case 1. K. S., female, aged 36 years, seen in January, 1929. For the past five years she had had dull pain under the right ribs. Five years ago, in March, 1926, she had severe pain on the right side, radiating to the back, with chills, vomiting, and hematuria. The urine was loaded with pus. Cystoscopic examination showed a congest-

ed bladder mucosa. Catheterization of the ureters showed pus coming down from both sides. A diagnosis of pyelitis was made. X-ray examination with catheters in place showed shortening and stiffening of the right ureter; however, this was not recognized at the time as being associated with tuberculosis.

At the next entry, in January, 1929, with the same complaints, cystoscopic examination showed ulceration and congestion of the bladder wall. X-ray films showed multiple calcified shadows in both kidneys, with shortening and stiffening of both ureters.

Guinea-pig inoculation was positive for tuberculosis on both sides.

Case 2. R. B., female, aged 22 years. Had upper abdominal pain, worse in left hypochondrium and flank for the past sev-

eral months. Nocturia, and burning pain upon urination.

Cystoscopy showed hyperemic, ulcerative bladder mucosa.

Pyelograms showed normal kidney pelvis on both sides. The right ureter, however, was straight and shortened.

Guinea-pig inoculation from the right side was positive for tuberculosis.

Upon removal of the kidney, the specimen was of twice normal size, the cortex destroyed by cystic degeneration, and filled with purulent material. A smear of this pus showed numerous tubercle bacilli. There was no involvement of the kidney pelvis.

CONCLUSIONS

Tuberculous involvement of the ureter is a frequent complication of tuberculosis of the kidney.

It may be present before involvement of the kidney pelvis can be demonstrated.

A diagnostic sign is straightening and shortening of the involved ureter, which can be determined by use of an opaque catheter.

REFERENCE

- DOORMASHKIN, RALPH L.: A Roentgen-ray Sign in the Diagnosis of Unilateral Renal Tuberculosis. *Jour. Urol.*, April, 1929, XXI, 455-464.

A CASE OF ADHESIONS OF THE SMALL BOWEL

By ARTHUR R. BLOOM, M.D.,
and
LOUIS J. GARIEPY, M.D.

DETROIT, MICHIGAN

Lesions of the small bowel are rarely suspected and, as a result, are seldom looked for. The following case is of interest in this respect.

S. W., a little girl six years of age, had been complaining of pain in the abdomen, associated with nausea, for six months prior to this examination. On two occasions she

vomited. For about ten days before we saw the patient, the pain had been getting worse although at no time was it sharp. Recently she had been awakened at about 3 A.M. with pain, relieved by pressure over the abdomen.

The child had had scarlatina and varicella in infancy. She had a perverted appetite, eating glass, chalk, paper and such things.

One of us (L. J. G.) was called to see the child on the morning following one of her nocturnal attacks. The parents thought that she had appendicitis, but the surgeon found that the abdomen was soft and that there was no tenderness and no elevation of temperature and, therefore, he did not think she had appendicitis but that she might have a partial obstruction resulting from the various foreign substances she ate. After several more attacks an X-ray study was ordered, for the purpose of ruling out the presence of foreign bodies in the gastrointestinal tract.

On February 5, 1931, a roentgen-ray study of the gastro-intestinal tract was started by one of us (A. R. B.). A preliminary film of the abdomen showed no evidence of opaque foreign bodies. The chest was normal. The stomach and duodenum were also normal as to size, shape, motility, and mobility.

At one hour there was 80 per cent of the barium mixture in the stomach, the remainder being scattered throughout the small bowel. A loop of bowel was located at about the middle of the abdomen, towards the left side, which was dilated. There was a marked to-and-fro movement. This appearance was also noted at later examinations at two, three, and four hours. At three and a half hours the stomach was empty. At twenty-four hours the colon was completely filled, with no barium in the small bowel. The appendix was filled, fairly mobile, and tender, the tenderness being located directly over the appendix and chang-

ing with its position. At forty-eight hours the cecum was empty but the appendix was still filled, and tender. An opaque enema revealed a normal contour of the colon. There was no evidence of foreign bodies.

pendix, which appeared chronically inflamed, was removed. Convalescence was uneventful and three months later the child was still free from symptoms.

Macroscopic examination of the appendix

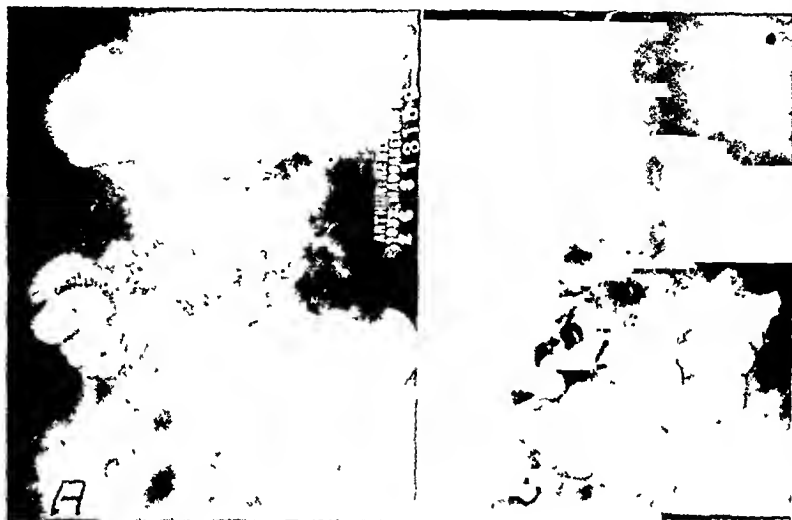


Fig. 1-A. Film made one hour after the barium meal. Note the dilated loop of small bowel in the lower left quadrant.

Fig. 1-B. Film of the same case made four hours after the barium meal. The dilated loop of bowel is still to be seen.

Roentgen Diagnosis.—Adhesions around a loop of small bowel causing a partial obstruction, and a pathologic appendix.

On February 8, the patient was admitted to the hospital. The physical examination failed to reveal any findings. No abnormal abdominal movements were noted on inspection. The urine was normal and the blood count showed 11,000 white blood corpuscles.

Operation by one of us (L. J. G.) revealed a loop of small bowel which was partially obstructed and dilated, due to adhesions. It was discolored, resembling in appearance an old bruise. The adhesions were divided and normal peristalsis passed through this segment of the ileum; the ap-

showed marked fecal retention. *Microscopic diagnosis:* Chronic catarrhal appendicitis, Grade 2, with fecal retention and pressure atrophy.

COMMENT

Here was a case which might have been diagnosed as subacute appendicitis, the appendix removed, and nothing further done. At operation, one would have been justified if he looked no farther. The same is true of the roentgen study. In these cases it is of importance to observe these patients hourly, paying particular attention to the appearance, motility, and position of the small bowel.

EDITORIAL

LEON J. MENVILLE, M.D. . . . Editor

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STANDARDIZATION OF HOSPITAL X-RAY EQUIPMENT

The Radiological Society of North America has realized for some time the need for standardizing hospital X-ray equipment. The first constructive evidence of its interest in this regard was manifested at the last annual meeting of the American Hospital Association, which was held in New Orleans, October, 1930. At this meeting the Radiological Society presented by invitation an educational exhibit, consisting of a fully equipped X-ray department, representing the type of X-ray apparatus found in a modern hospital of moderate size. This demonstration was perhaps the first of its kind ever presented before such a large body of hospital authorities.

Many inquiries were made concerning the nature and purpose of this exhibit, by superintendents of private, municipal, state and government hospitals, and also from officials of the United States Public Health Service. They were mainly interested in knowing whether the Radiological Society could furnish specific information in regard to the type of necessary X-ray equipment for hospitals of different sizes. It was mentioned by them that authoritative information pertaining to hospital X-ray equipment was not available, and that because of the practical application of such knowledge and also the responsibility involved in purchas-

ing such apparatus, they believed it should be the duty of some recognized body of radiologists to sponsor an investigation. They were of the opinion that such an investigation should obtain accurate knowledge relative to equipping hospitals with suitable X-ray apparatus, and that this information should be disseminated among the hospital authorities and the medical profession of this country.

The Radiological Society assumed this responsibility when it presented its exhibit at the meeting of the American Hospital Association. It, therefore, behooves this Society to institute a survey which will ascertain the type of equipment used in the different X-ray departments of the various hospitals in this country. In this manner, first-hand information would be procured in compiling valuable statistics for a study to standardize hospital X-ray equipment, and incidentally to acquire other valuable data of interest to the radiological and medical profession.

Such an investigation would serve to verify a current opinion that the purchase of X-ray equipment for a hospital is often made upon the recommendation of high pressure salesmanship, often without proper regard to the requirements and needs of the institution. It would not be surprising, therefore, to find that some of the hospitals have X-ray equipments in excess of their needs, and others are inadequately furnished. For instance, it is not considered necessary for a 15-bed hospital to have a super-deep X-ray apparatus, because the demand for its use in such a small hospital would be negligible. There can be no objection to such a hospital owning this apparatus, but if its purchase was made on the recommendation that it was an indispensable piece of equipment for a hospital of that

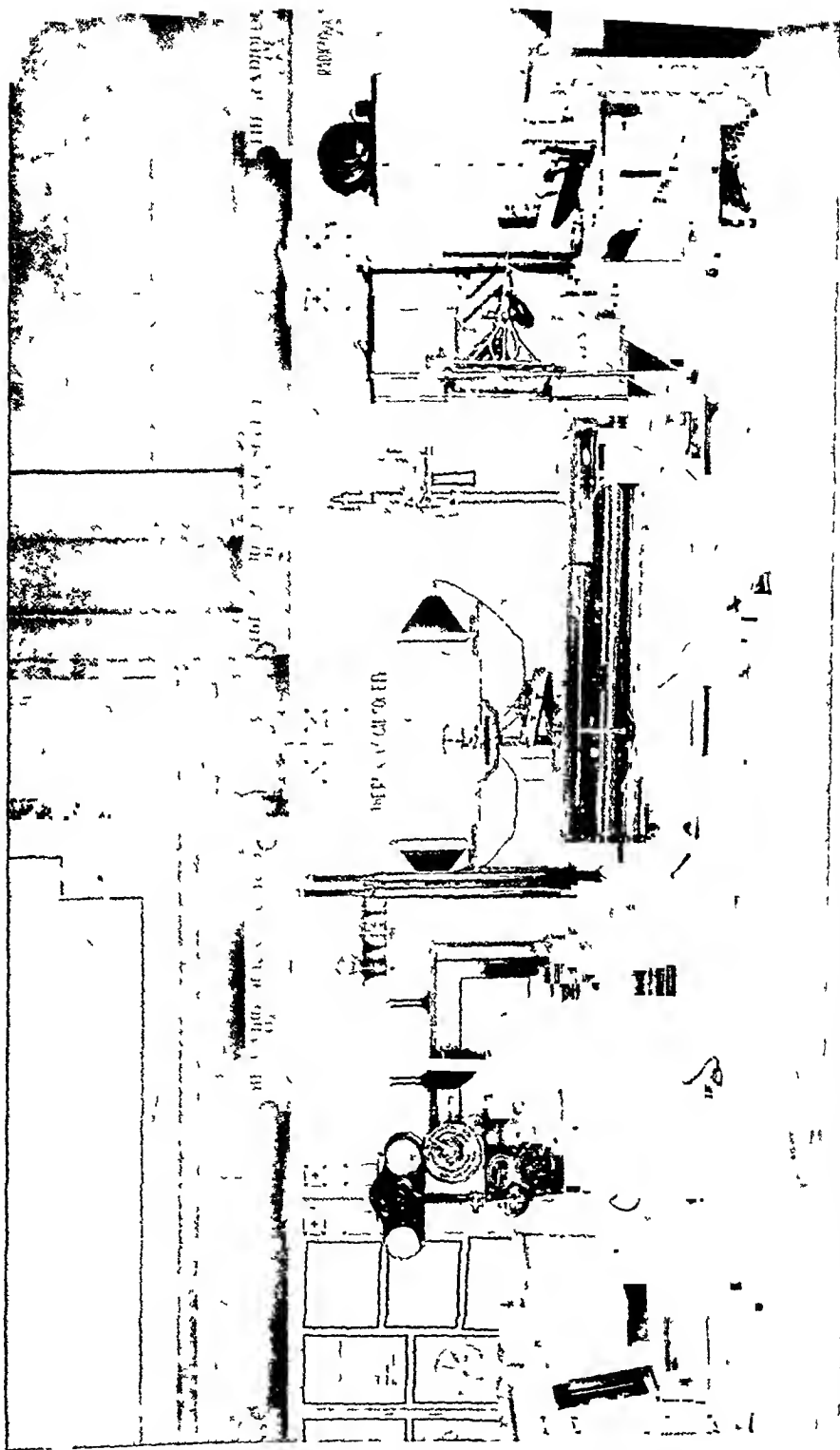


Fig 1. An educational exhibit, demonstrating a fully equipped X-ray department for a hospital of moderate size, presented by invitation at the New Orleans (1930) meeting of the American Hospital Association, by the Radiological Society of North America. See figure 2 for further description. The success of this exhibit was the result of the co-operation of Dr Robert J May, then President of the Society, and Dr. I S Trostler, Secretary and Treasurer, and the valuable assistance of one of our prominent X-ray manufacturers, who generously loaned the apparatus without any display of advertising matter.

size, then an injustice has probably been done the institution.

Incidentally, the investigation may reveal that some hospitals are equipped with only a portable machine or its equivalent, and some have no X-ray apparatus at all. It would be interesting to know, in an instance wherein a hospital was equipped with only a portable machine, whether its staff was acquainted with the prevailing situation, and also if the X-ray reports were considered accurate.

The ultimate result of such an extensive investigation would be of momentous importance in its practical application to the standardization of hospital X-ray equipment, and would be a sure indication of an earnest desire on the part of the Radiological Society of North America to actively co-operate in any enterprise in which organized medicine is interested.

DR. M. J. HUBENY, AS WE KNOW HIM¹

The resignation of Dr. M. J. Hubeny as editor of *RADIOLOGY* has come as a real loss to the members of the Radiological Society.

As members of the Publication Committee we have been brought into close contact with Dr. Hubeny for many years, and this journalistic association is one we shall sever with the feeling of deep regret.

It is easy now, when the success of our Journal is assured, to forget the years of unremitting toil which have been given to it, or the many vicissitudes through which it has passed. Some of us will recollect the time when we were faced with such difficult problems that it seemed as if we might not be able even to survive. The Journal was faced with litigation, and we had no funds

with which we might fight for our rights; we were without the proper records, and were quite in the dark as to how we might best carry on, so that it might be edited with experience; and, further, we had still a reputation to make ere we could command the respect, attention, and support of the radiological field.

To find someone who was able and willing to take over this stupendous task, and build us up a new Journal, under such handicaps, was no light undertaking, and it was a very fortunate, opportune, and wise selection that saw in Dr. Hubeny the man we needed. We may well congratulate ourselves that in the days of such difficulty we had found one who was willing to give of himself so generously, in time, in energy, and in money, that he might succeed in the task to which he had set himself.

Such a condition might well strain the reputation of the best of men, as it needed not only editorial ability, but great skill in handling this most difficult situation. But in spite of these trying circumstances Dr. Hubeny was persuaded to accept the post, and henceforth he made it his own work, with such results as we all know. It is due to his untiring efforts and singular ability that we have a Journal to-day of which we may well feel proud.

In the beginning he was immediately faced with the most strained situations, and only by his own grace and acceptability were they overcome, winning over to us many who later have given us much good service. Along with the officers he shouldered our legal troubles, and, at more cost in time and money than we shall ever know, never rested until he had freed us from the stigma of litigation, and the Society had won the right to publish its own Journal.

But most of all may we appreciate his work as editor-in-chief of *RADIOLOGY*. In splendid anonymity he has remained in the background and we see only the fine contributions from many illustrious sources. It

¹Received for publication June 17, 1931.

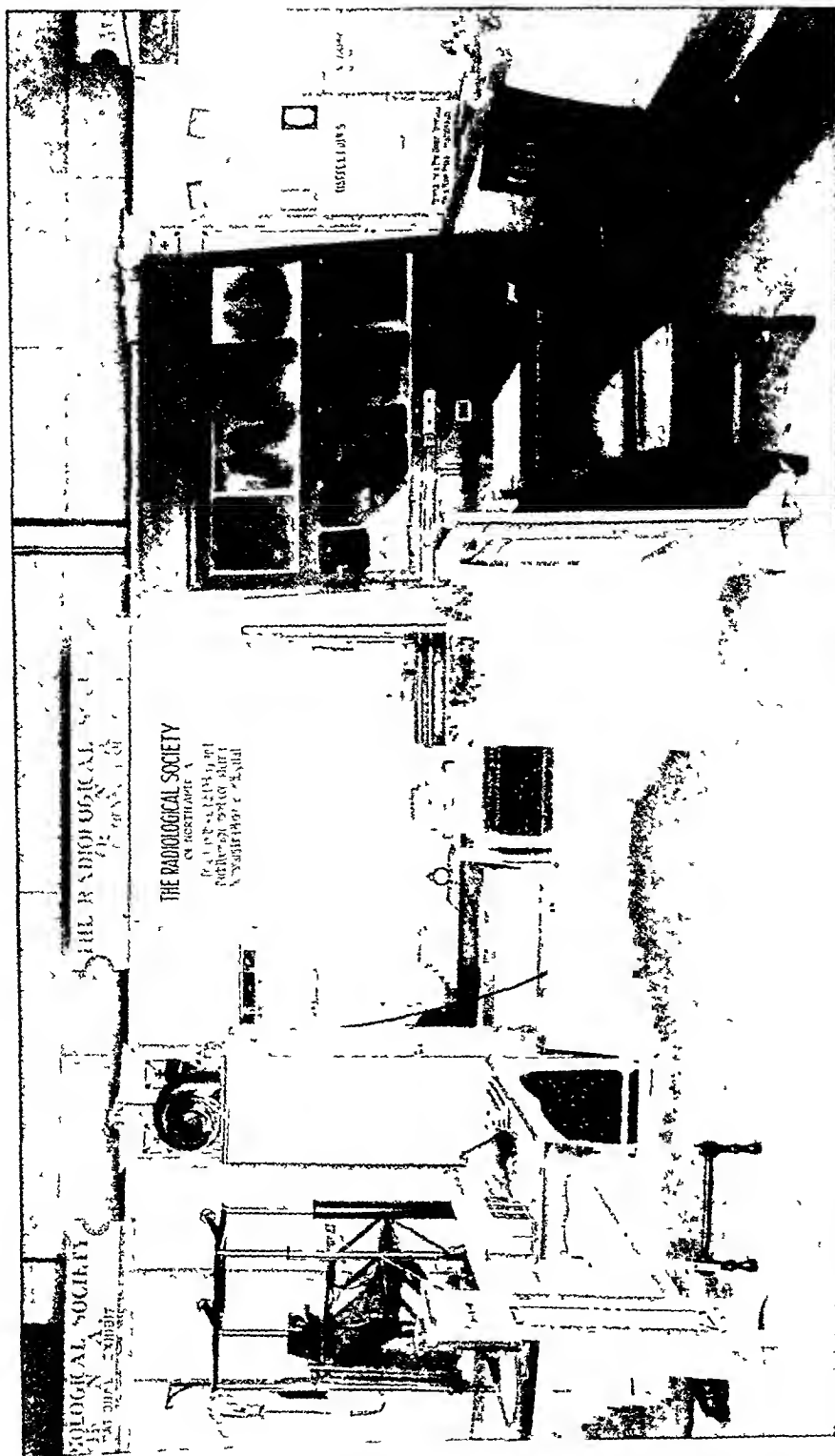


Fig. 2. This exhibit was divided into three sections: (1) the office of the roentgenologist, containing, besides the usual office furniture, a filing cabinet for films and an X-ray illuminator upon which was displayed many interesting films obtained from New Orleans hospitals; (2) the developing room, equipped with electric dryer, time clock, and other appliances used in developing X-ray films; (3) the examining and treatment room, containing apparatus modern in design and efficiently arranged. On the walls were displayed numerous interesting placards, furnished by Dr. I. S. Trostler, explaining the dangers to which patients expose themselves when being examined or treated roentgenologically by non-medical men.

has taken years of the most patient work to win us the regard in which we now stand. Of the drudgery of that work, of the great persistence it required, especially during those early years, we know nothing. The results are apparent to us all, and we may well take this opportunity of congratulating Dr. Hubeny on the success of his editorship of the Journal as we see it to-day. For it is to his unselfish devotion alone that we owe its success. We acknowledge our debt to him, and realize that in losing him we lose an editor of outstanding ability and a guide whose hand we shall miss.

To have been associated with Dr. Hubeny is to have felt an ever-increasing respect for him. We see in him a man who has committed himself with fortitude to the high purposes of this life, and has accepted the challenge offered to all of us. As he goes forward with single aim to accomplish his life work he will carry with him our esteem and regard, and the best wishes of his fellow-members of our Society.

Publication Committee,

DR. W. H. MCGUFFIN, *Chairman,*

DR. R. H. STEVENS,

DR. R. J. MAY.

ANNOUNCEMENTS

SECTION ON RADIOLOGY OF AMERICAN MEDICAL ASSOCIATION

The Section on Radiology at the Philadelphia meeting held three morning sessions: Two sessions were devoted to diagnostic radiology, the third to radiotherapy.

At the therapy session, Dr. Sosman, of Boston, spoke on xanthomatosis in bone, describing both the diagnosis and the treatment with X-ray, which is empirical, but results in certain beneficial effects.

Dr. J. Thompson Stevens, of Montclair, N. J., read a paper giving his results in a large series of cases of hyperthyroidism.

Dr. G. E. Pfahler, of Philadelphia, spoke on the treatment of cancer of the lip. He mainly uses electrocoagulation or radium on the primary lesion and gives very intensive doses of radium or high voltage therapy over the surrounding area and the regional lymphatics. Dr. Pfahler showed many brilliant results which he has secured by this treatment.

Dr. Howard A. Kelly, of Baltimore, read a paper on the radiation treatment of menstrual disorders. Dr. Kelly stressed the necessity of complete and accurate diagnosis before such treatment is given. In dysmenorrhea in young girls the prospect is not very encouraging. In excessive bleeding around the menopause, either from small fibroids, or in cases in which no gross disease is demonstrable, the results are excellent. Dr. Kelly's paper and Dr. C. C. Norris' discussion were listened to with much interest.

Dr. Isaac Levin, of New York, gave his results in cancer of the breast treated with a combination of surgery and radiotherapy.

Dr. Ira I. Kaplan, of New York, reported his method of treating advanced cases of cancer of the rectum at the Bellevue Hospital. One gathered that Dr. Kaplan preferred contact applications of radium without colostomy or other surgical operation for this type of case.

The Chairman's address, while not delivered at this session, was on a therapeutic subject, "Accuracy in Roentgen-ray Dosage." Dr. Erskine stressed the importance of accurate measuring devices for both superficial and deep roentgen-ray treatment.

The diagnostic papers began with one by Dr. A. B. Moore, of Washington, D. C., on the roentgen diagnosis of chronic appendicitis. The point on which Dr. Moore laid particular emphasis was the value of fixation as a sign and the technic of the various

fluoroscopic procedures necessary to elicit this sign.

Dr. Maurice Dwyer, of Seattle, Washington, read a paper on the results of cholecystectomy, which, incidentally, included a comparison of the roentgen diagnosis with the operative findings. It also included a complete follow-up on cases operated on, with a tabulation of results as regards relief from the symptoms of which the patient had complained pre-operatively. In his series about 50 per cent of the patients had complete relief from operation.

Dr. John L. Kantor, of New York, spoke on anomalies of the duodenum and colon and their relation to normal function. The demonstration was exhaustive and included all types of malformation, from those having only anatomical significance to those which demand immediate relief by radical measures.

Gastric polyposis was dealt with by Dr. B. R. Kirklin, of the Mayo Clinic. He showed examples of all the various types, from the small single polyp to the very extensive general polyposis, stressing the point that malignant degeneration may occur in these polyps.

The relation of accessory nasal sinus infection to lung symptoms was discussed by Dr. John D. Osmond, of Cleveland, Ohio. He pointed out the frequency with which pulmonary tuberculosis is suspected or diagnosed when the actual pathology is in the nasal sinuses.

Dr. Ernest A. Kraft, of Chicago, read a paper on melorheostosis (Leri), an unusual type of abnormal bone proliferation. He reviewed the literature and reported two cases of his own which demonstrated very well this rare bone disease.

Dr. Samuel Brown, of Cincinnati, Ohio, gave a very interesting discussion on pathologic conditions of the diaphragm. He presented what he believes to be a new sign of subdiaphragmatic abscess, namely, an up-

ward displacement of the posterior part of the diaphragm, shown, of course, only in the lateral view.

Dr. John T. Farrell, Jr., of Philadelphia, presented a very complete study of the chest in cases which had been operated on for lung abscess. A thorough follow-up in cases of this sort is not often available and a study of the material presented by Dr. Farrell will be very helpful.

Dr. E. C. Vogt, of Boston, presented an original research in the X-ray study of the bones of children suffering from lead poisoning. Dr. Vogt showed many films demonstrating a deposit of metallic lead near the ends of the long bones in this disease. He also showed the disappearance of this dense line in the bones as the children recovered from the disease. Study of the bones in children who have died from the disease proves that the characteristic dense line shown on the X-ray film is actually due to lead and not to some alteration in the normal mineral salts of the bone. Dr. Vogt warns against confusing this line of opacity with the similar change seen in healed rickets.

Dr. I. S. Trostler, of Chicago, read a very timely paper stressing the importance of making X-ray reports comprehensive, accurate, and intelligible to the referring physician.

Dr. Robert B. Taft, of Charleston, S. C., presented a paper on roentgen diagnosis of mastoiditis, mostly in children. He discussed the difficulties of making satisfactory examinations in young patients and demonstrated his own technic for this purpose.

All the sessions were well attended and the program appeared to hold the attention of those present. The success of this meeting must be a source of great satisfaction to those of our confrères who worked so hard to establish this Section on Radiology.

G. W. GRIER, M.D., *Secretary*.

PENNSYLVANIA RADIOLOGICAL SOCIETY

The Sixteenth Annual Meeting of the Pennsylvania Radiological Society was held in McKeesport, May 13 and 14, 1931, with an excellent program given by essayists representative of the radiologists of the State. The guest speakers were J. L. Weatherwax, M.A., and Charles Robb, of Philadelphia, and J. A. Bargen, M.D., of Rochester, Minnesota.

The officers of the Pennsylvania Radiological Society are: A. R. Snedden, M.D., of McKeesport, *President*; J. J. Singer, M.D., of Greensburg, *First Vice-president*; W. J. Sterrett, M.D., of Pittsburgh, *Second Vice-president*; W. E. Reiley, M.D., of Clearfield, *Secretary-Treasurer*; G. D. Bliss, M.D., of Altoona, *Editor*. The Radiological Society of North America is proud to say that all of these physicians are among its members.

THE ST. LOUIS MEETING RAILROAD INFORMATION

The passenger associations throughout the United States and Canada have authorized a rate of one and one-half fare for the round trip to the St. Louis meeting of the Radiological Society of North America for the benefit of members of the Society and dependent members of their families, who will attend the Annual Meeting next Winter.

In order to have the benefit of a return rate of one-half fare, it will be necessary for each member to secure a Certificate from the railroad ticket agent when purchasing a ticket to St. Louis. The Certificate must be deposited with your Secretary at the registration desk upon arrival at the meeting. After 150 of these Certificates have been

deposited they will be signed by your Secretary and validated by the representative of the railroad company, after which they may be reclaimed by their owners and will be honored for one-half the return trip fare.

If the ticket agent at the member's home city does not have Certificates, each member should secure a receipt or information where such Certificate can be obtained. It would be well for all members expecting to attend the St. Louis meeting to see their railroad agents soon and ask that they secure Certificates in advance.

While the railroads are granting these greatly reduced rates for many meetings and conventions, the statistics of railroads show that the number of occasions attracting a number of 150 or more persons by rail is gradually decreasing. We have represented to the railroads that reduced rates are essential to the success of our meeting, and the railroads are glad, of course, to cooperate in an effort to make it so, but in many cases the small number of tickets sold by the railroads would seem to indicate that members individually are little concerned as to whether or not the reduced railroad rates are available, since they are more and more using other means of transportation in travelling to and from the places of meeting. This, of course, works to the disadvantage of their fellow-members, particularly where arrangements have been authorized on the Certificate plan and the special rate on the return trip is dependent upon the presentation of 150 or more Certificates. It has frequently happened that a hundred or a hundred and twenty-five have travelled by rail, paying full fare on the going trip with the expectation of securing one-half fare returning, while the remainder of those attending the meeting have used automobiles or buses and thus made it impossible for those who actually travelled by rail to secure any reduction. Fortunately, this has never occurred in connection with our meetings

but I am making this communication so that it may not occur at St. Louis.

Therefore, as the carriers have complied with our request and have authorized these special rates for those attending the meeting of the Radiological Society at St. Louis I sincerely trust that all members will travel by rail so that the railroad ticket sale and registration of Certificates will be sufficient to permit of the return trip at one-half fare.

I. S. TROSTLER, M.D.

THE AMERICAN COLLEGE OF PHYSICIANS

The American College of Physicians will hold its Sixteenth Annual Clinical Session at San Francisco, with headquarters at the Palace Hotel, April 4-8, 1932. Following the Clinical Session, a large percentage of those attending will proceed to Los Angeles, where a program principally of entertainment will be furnished April 9, 10, and 11.

Announcement of the dates is made particularly with a view not only of apprising physicians generally of the meeting, but also to prevent conflicting dates with other societies that are now arranging their 1932 meetings.

Dr. S. Marx White, of Minneapolis, is President of the American College of Physicians, and will arrange the Program of General Sessions. Dr. William J. Kerr, Professor of Medicine at the University of California Medical School, San Francisco, is General Chairman of local arrangements, and will be in charge of the Program of Clinics. Dr. Francis M. Pottenger, of Monrovia, is President-elect of the College, and will be in charge of the arrangements at Los Angeles. Mr. E. R. Loveland, Executive Secretary, 133-135 S. 36th Street, Philadelphia, Pa., is in charge of general and business arrangements, and may be addressed concerning any feature of the forthcoming Session.

REPRINTS OF CASE REPORTS

We are happy to announce that, through the generosity of the Chemical Foundation, RADIOLOGY is able to furnish 100 reprints (without covers or envelopes) to authors of Case Reports, upon request. In the past this service was of necessity reserved to the authors of papers of fuller length.

We hope our readers will interpret this as a desire on the part of RADIOLOGY to cooperate with them to the fullest extent in the building up of an extensive Case Report Department.

H. P. DOUB, M.D.

Associate Editor for Case Reports.

IN MEMORIAM

JOHN ROBERT KELLEY

1871-1931

John Robert Kelley, a well known and highly respected pioneer in the manufacture of roentgen apparatus, passed away on April 23, 1931, in his sixtieth year.

He was born in Thessalia, Virginia, where, as a boy, he experimented in telegraphy and learned to send and receive Morse code. He also worked for a few years as a commercial telegrapher. He entered commercial life, yet studied and experimented in electricity, because he had become deeply interested in the discovery of Roentgen. In fact, he used all his means and spare time in X-ray experiments.

In 1902 he moved to Covington, Kentucky, where for months he sought to interest men in financing a factory for the manufacture of X-ray apparatus. Shortly after meeting Albert B. Koett, a partnership was formed and a factory started in a small shed-like structure. The business prospered so that the firm soon moved to larger quarters and again enlarged, after a short interval, until finally the factory of the Kelley-

Koett Manufacturing Company was built and occupied.

It is the writer's belief that this firm's interest in radiology did much to foster and advance the knowledge of apparatus in the early days when little was known of the possibilities, characteristics, and dangers of the machinery of the then young science. Much of the apparatus used in the field hospitals of the U. S. Medical Corps during the World War was designed by "Bob" Kelley and produced by his firm.

He was an enthusiastic motorist and advocate of good roads, at the time of his death being President of the Northern Kentucky Motor Club. Although not a politician, his services were much in demand by political and governmental bodies. Governor F. D. Sampson appointed him to the Kentucky State Progress Commission and his associates in this body immediately elected him Vice-chairman. He had recently been elected Chairman of the Executive Committee of the Summit Hills Country Club. He was also an enthusiastic aviator, having made numerous more or less extended flights. In local affairs his keen foresight and broad knowledge were much sought after, with the result that at various times he occupied numerous public positions of responsibility and prominence. He had been honored in the various Masonic bodies.

Hon. F. D. Sampson, Governor of Kentucky, in a proclamation closing the State offices for the funeral, said in part: "Col. Kelley, as Vice-chairman of the Kentucky Progress Commission, has rendered a significant, public-spirited service to Kentucky, devoting almost his entire time at a sacrifice of business and the calls of other civic organizations to a whole-hearted, unselfish effort to promote the welfare, advancement, and prosperity of his beloved State.

"Receiving and seeking no remuneration, spending unstintingly of his means and energy, jeopardizing his very life in a

patriotic cause that his keen vision saw must be vigorously prosecuted and sustained to raise the status of his State to the proper place in the Nation, Col. Kelley has rendered an invaluable service to the Commonwealth of Kentucky and to his fellow-citizens." Other tributes of similar type were rendered by Charles Eugene Clark, a prominent Covington attorney, and the newspapers of Covington (Kentucky) and Cincinnati (Ohio), showing the high regard in which he was held.

Although "Bob" knew that he had an inoperable gastric carcinoma, his morale was such that he was not heard to complain, and as recently as the last meeting of the Radiological Society in Los Angeles, last December, he was actively interested in the meeting and joined his many friends in the events of that occasion. He had been present at every meeting of this Society and accompanied all the pilgrimages and tours except the last California train.

He was a reliable business associate, a good citizen, a cheerful, agreeable companion and friend, and in every way a fine gentleman.

I. S. TROSTLER, M.D.

BOOK REVIEWS

PRACTICAL X-RAY TREATMENT. By ARTHUR W. ERSKINE, M.D., Cedar Rapids, Iowa. Pages 116, with numerous charts and illustrations. Bruce Publishing Company, Saint Paul, Minnesota, 1931. Price \$3.50.

This book, which the author says is not written for expert roentgenologists, takes up in a practical way the use of three routine technics (two at 135 and one at 200 kilovolts) in roentgenotherapy. The author has set down his personal opinions, has avoided controversy about methods, and has,

throughout the whole book, emphasized accuracy in treatment so that both underdosage and overdosage may be avoided.

The main body of the book (the first 66 pages) takes up—in order—current, apparatus and protection, measuring instruments, factors affecting skin dosage, factors affecting the depth dose percentage, and standard technics from a non-mathematical, descriptive, physical point of view. There, then, follows a chapter on the skin dose (pages 67 to 74), on the effects of roentgen rays on tissues (pages 75 to 80), on skin diseases (pages 81 to 91), on non-malignant conditions (pages 93 to 100), and finally one on the roentgen-ray treatment of malignant conditions (pages 101 to 112).

The presentation of the physical side of the "moderate voltage" technics merits special commendation because most other texts on roentgenotherapy have glossed over this very important subject.

The make-up of the book leaves nothing to be desired and is in perfect accordance with the publisher's high standard.

It is hoped that in future editions more space will be allotted to a discussion on the quality of roentgen rays and that some notes on valve rectifiers and autoprotecting tubes will be included. From the clinical point of view it seems that the treatment of lymphoblastoma should be emphasized more, that the chapters on cancer of the uterus and on sarcoma should be enlarged, that something about tumors of the testis should be included, and that the whole section on treatment of cancer should be expanded to about twice its present length.

This book will appeal to the student who is already familiar with the fundamentals of roentgen therapy but who is not quite ready to delve into the complexities of the mathematical and physical aspects of treatment, and to anyone seeking practical, useful information that will enable him to do good treatment work away from a large institution with its wealth of facilities.

TECNICA RADIODIAGNOSTICA. By PROF. M. PONZIO, Director of the Maurizian Radiological Institute of Torino, Turin, Italy. A volume of the Collection of Medical Manuals, published by the Unione Tipografica, Turin, Italy, August, 1930. With 350 figures in the text and 96 half-tone illustrations.

This concise book of nearly five hundred pages covers the ground of roentgen physics and diagnosis. The General Section of 158 pages discusses the nature of the X-ray; various types of generating apparatus and tubes; methods of measuring X-rays; accessory instruments, including the latest compressor diaphragm; an adequate discussion of the Bucky diaphragm, with a description of Potter's work to perfect and utilize Bucky's idea, and many other data relative to the technical side of X-ray work. The author offers an excellent scheme of classification for a radiographic library. The second part of the book, comprising the remainder of 438 pages, is devoted to a discussion of clinical radiological diagnosis, which is notable for its completeness, considering the small compass of the work. The illustrations are excellent, especially those which are included in the tables printed on special paper as inserts. The final chapter is devoted to the localization of foreign bodies.

JAMES T. CASE, M.D.

MALADIES DE L' APPAREIL RESPIRATOIRE. Pathologie médicale, tome III. Collection de Précis Médicale. Written by FERNAND BEZANCON, MARCEL LABBE, LEON BERNARD, J. A. SICARD, A. CLERC, P. EMILE WEIL, A. PHILIBERT, S.-I. DEJONG, A. SEZARY, PASTEUR VALLERY-RADOT, TH. ALAJOUANINE, CH. FOIX, G. VITRY, M. BLOCH, JEAN PARAF, ANDRÉ BLOCH, J. THIERS. Second Edition, 1931. Masson and Company, Paris. Pages 747, many illustrations and 36 roentgenographic plates. Price 70 francs.

This compact book is the third volume of a series of short treatises on different phases of medical pathology designed to give to the student and practising physician a summary of the latest ideas on diseases of the respiratory apparatus. The size, typography, character of illustrations, and general bookmanship are in keeping with the purpose of the work. An excellent index is provided. The clinical and pathologic descriptions of the different varieties of respiratory diseases are excellent. Unlike many other even more important text-books, of which a common fault heretofore has been to neglect the radiologic aspects of the diseases treated and to overlook the diagnostic and therapeutic assistance which radiology has been shown to furnish in many such diseases, this work incorporates such information in a satisfac-

tory manner. Especial attention is given to the infectious and other inflammatory diseases. The discussion of asthma in general is adequate. The only important defect is that so little space is given to description and discussion of intrathoracic tumors. For instance, carcinoma of the lung is dealt with in sixteen pages interpolated between the two parts of the book dealing with the acute and chronic respiratory diseases, respectively, and only a little over one page is devoted to mediastinal tumors. Therefore, it may be said that while the authors have done ample justice to the acute and chronic respiratory inflammations, the injustice done to intrathoracic tumors in general constitutes a glaring defect. In every other respect, however, the work is to be commended.

A CORRECTION

The paper entitled "The Story of the First Roentgen Evidence," by Sanford Withers, M.D., of Denver, Colorado, was read before the Radiological Society of

North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1-5, 1930. A footnote to this effect was inadvertently omitted when the paper was published in *RADIOLOGY*, July, 1931, XVII, 99.

ABSTRACTS OF CURRENT LITERATURE

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ABDOMEN

Ossification in a Laparotomy Wound. Philip G. Silver. Can. Med. Assn. Jour., March, 1931, XXIV, 414.

This is a case report of a development of true bone in an abdominal wound, following cholecystectomy.

Ten days following the operation, the patient felt soreness in the upper end of the abdominal wound. Three weeks later a small pocket of pus was found in the upper end of the abdominal incision, and was evacuated. Shortly afterward, induration began to be noticed in the wound. This became steadily more pronounced until the scar became as hard as bone. Radiographs were taken six weeks and two months after the operation, but there was no evidence of calcification on either occasion. Three months after the operation, the first sign of calcification was seen on a radiographic film. On account of pain and resulting disability, the calcified area was removed and found to be a piece of bone 12 cm. in length and 4 cm. in width. It apparently had originated in the aponeurosis and not in the rectus muscle itself.

The author discusses the various theories as to the genesis of myositis ossificans. Practically all of these theories are elaborations of one or the other of the two opposing basic theories, the "periosteal" theory and the theory of "true metaplasia." The periosteal theory assumes that the newly formed bone in the muscle arises from the periosteum of a neighboring bone. The theory of true metaplasia assumes that connective tissue cells present in the fibrous tissue septa of muscles may, under certain conditions, develop into true bone-forming cells.

In the case of bone forming in laparotomy wounds, the periosteal theory is hardly applicable, and one is obliged to consider other factors. The view generally accepted is as follows: The lineæ transversæ, representing the remains of the extension forward of the ribs, and the white line representing the prolongation downward of the sternum, may sometimes contain osteogenic elements. These elements,

lying dormant there, are stimulated by injury to proliferate, and new bone is formed.

L. J. CARTER, M.D.

A Case of Pyloric Stenosis Due to Pancreatic Cysts. E. Furrer. Schweiz. med. Wchnschr., Feb. 14, 1931, LXI, 162.

This is a case report of a patient who, for two years, had pain in the upper abdomen often accompanied by vomiting, especially after the morning meal. A roentgen examination demonstrated a large filling defect in the region of the pylorus; this was interpreted as a carcinoma. On operation, a large thick-walled cyst of the head of the pancreas was disclosed.

H. C. OCHSNER, M.D.

A Contribution to the Diagnosis *in Vivo* of the *Situs Inversus* of the Abdominal Organs: Report of Three Cases. A. Determann. Röntgenpraxis, March 15, 1931, III, 251.

Three cases of partial *situs inversus* of the abdominal organs are described. The chest organs were in normal position. Although it is possible to make a definite statement as to the position of the stomach, duodenum, gall bladder, and colon by roentgenographic means, the position of the liver and spleen cannot be made with certainty in all cases.

H. W. HEFKE, M.D.

Acute Pyopneumothorax: A Case in an Infant Aged Nine Weeks. Julian L. Rogatz and Albert Rosenberg. Am. Jour. Dis. Child., May, 1931, XLI, 1104-1110.

After a careful review of the literature, the authors found only one case, in addition to their own, of acquired acute pyopneumothorax, proven by autopsy observations, in infants under three months of age.

A bedside roentgenogram showed pneumothorax of the left side, with vertical and horizontal bands, which suggested the appearance of a diaphragmatic hernia. The heart and mediastinum were slightly displaced to the right. Twenty-four hours later, following a

barium meal, a roentgenogram showed the pneumothorax to be increased in size. A Y-shaped shadow noted was found, at autopsy, to have been due to adhesions. The barium was seen in the stomach below the diaphragm, thus ruling out the possibility of diaphragmatic hernia. The etiology was attributed to furunculosis, the onset of which was noted at the age of four weeks.

F. B. MANDEVILLE, M.D.

The Importance of Roentgenographic Examinations in Acute Cases of Circumscribed or Diffuse Peritonitis. Anders Westerborn. Surg., Gynec. and Obst., April, 1931, LII, 804-814.

In order that the patient may not be subjected to a long procedure, the abdomen and thorax are fluoroscoped and films made without the aid of a barium enema; however, if necessary, one is given. The patient is placed in the supine position and the diaphragm is studied for mobility. He may be turned from side to side, in order to bring out suggestive areas in the abdomen. Inflammatory processes in the abdomen give the appearance of increased gas and fluid content, with diminished motility of the intestine. Fluid level may be determined, and large homogeneous shadows may be surrounded by gas-filled intestinal coils.

With the barium enema, an abscess may show an impression on, or compression of, the intestinal lumen, which may have an even or a jagged outline, diminished motility of the diaphragmatic leaf, or exudate in the phrenicocostal sinus. In some cases, the disappearance of the shadow of the psoas is noted.

Case histories and reproductions of roentgenograms illustrative of these points accompany the paper.

D. S. CHILDS, M.D.

APPENDIX (DIAGNOSIS)

The Radiological Diagnosis of Chronic Appendicitis. Paul Jacquet and Léon Gally. La Presse Méd., March 14, 1931, XXXIX, 376-379.

The authors have found the radiological diagnosis of chronic appendicitis to be accurate and reliable. The technic employed by them

depends upon the examination of the terminal ileum and cecum six hours after the ingestion of a meal containing 200 gm. of barium.

Localization of the Site of Tenderness.—Often tenderness ascribed clinically to the appendix is found to be due to pelvic cellulitis, neuralgia of the visceral plexus, pelvic adenopathy, and, most frequently, pain referred to the abdominal wall from some viscus, such as the bladder. The tenderness elicited by pressure must coincide with the internal border of the cecum, as revealed on the screen, and follow it in all positions before it can be ascribed to the appendix.

Delay at the Ileocecal Junction.—In the normal subject the barium fills the ascending colon to the hepatic flexure in six hours, only a small residue being visible in the ileum. If the appendix is affected, there is a residue in the ileum, at least equal to that already in the colon, and the ileum is hypertonic, the barium being massed in isolated loops. Delay at the ileocecal junction of twenty-four hours or more has been found to be only rarely associated with chronic appendicitis, and is more often due to organic stenosis, caused by cancer of the ileocecal region, tuberculosis of the cecum, or adhesions.

Ileocecal Spasms.—These have not been encountered, except in cases of appendicitis. Sometimes they take the form of general contraction of the cecum and ascending colon, and occasionally are localized. They may be visible without palpation, but often may be evoked by pressure on the site of tenderness, and their presence may be demonstrated on the film by the maintenance of a moderate degree of compression, by means of a small air cushion. A contraction in the cecum is often seen on the lateral border, opposite the tender point, and is analogous to the incisura opposite a gastric or a duodenal ulcer. The ileal spasms are essentially localized and transitory.

Visualization of the Appendix.—The appendix is rarely visualized at six hours, and can more often be seen filled at twelve or twenty-four hours, when the cecum is on the point of emptying. Valuable confirmation is obtained if the appendix and the site of tenderness are found to coincide, but this is not indispensable.

Pyloric Irregularity.—The stomach often

empties irregularly, although appearing to empty rapidly; at six hours a residue is still to be seen in it, while at other times, although at first inactive, it is found to have evacuated the meal in one or two hours. Generally, when there is abnormal behavior both at the pylorus and the ileocecal junction, the authors have found the appendix to be at fault.

CHARLES WROTH, M.B., D.M.R.E.

BLADDER

Bladder Diverticula and Their Surgical Removal. J. S. Eisenstaedt. United States Vet. Bureau Med. Bull., April, 1931, VII, 313.

The author believes that increased intracystic pressure, due to obstruction or infection or both, is an important factor in the formation of diverticula, in congenitally weakened regions of the bladder wall. The most frequent site of the occurrence of these herniations is in the vicinity of the ureteral orifices. The size may vary from a cavity containing a few c.c. to one containing several liters.

In the series of cases reported by the author, microscopic examination of the walls of the diverticula revealed that all layers of the bladder wall were represented. In the presence of prolonged infection the walls were found to be markedly thickened. However, as a result of stretching, some of the cases showed thinning of the walls with flattening of the lining epithelium.

Infection of a diverticulum frequently occurs, and, because of the location of the cavity and its narrow contracted orifice, it is almost impossible to overcome the invading organisms. Other associated conditions are calculi, or tumors, found within the diverticulum.

Vesical diverticula are usually symptomless unless infected. No characteristic symptoms are observed and they appear as various disturbances of urination, depending on associated pathology. The diagnosis is made by cystoscopy and cystography. A series of cystograms affords the best method of accurate diagnosis, especially in those cases in which cystoscopy is impossible or difficult. In some cases it is found possible to coil a shadowgraph catheter in the cavity. Subse-

quent roentgenographic studies give valuable information regarding the size and location of the diverticulum. Intravenous urography, likewise, should be especially valuable in examining cases in which instrumentation is dangerous. Roentgen-ray exposures should be made in supine, lateral, and semi-lateral positions. Stereoscopic films are also valuable aids.

The treatment of diverticula of the bladder is complete surgical removal unless the general condition of the patient prohibits operative interference.

J. N. ANÉ, M.D.

Bladder Tumor: Survey of Fifty Cases. R. F. Mathews. Am. Jour. Surg., February, 1931, XI, 343-353. (Reprinted by permission from British Med. Jour., May 9, 1931, No. 3,670, p. 86 of Epitome of Current Medical Literature.)

The author defines three groups of bladder tumors: (1) growths, either papillomatous or pedunculated, which project well into the bladder; (2) sessile growths which spread laterally along the bladder mucosa and project less into the bladder, and (3) infiltrating growths, which invade every layer of the bladder and of the surrounding bladder tissue. Bladder tumors are either benign, the papilloma being the most common of this type, or malignant, such as malignant papilloma, papillary carcinoma, adenocarcinoma, and epithelioma. The benign papilloma is always intravesical and begins as a tiny excrescence on the surface of the epithelium. Later on this frequently becomes malignant, with thickening of the epithelial layers, multiplication of the layers, and fusion of the papillæ. Bladder tumors are most common in the region of the trigone and ureteral orifices, and occur in males and females in the proportion of 4 to 1. Secondary effects of bladder tumors are bleeding, obstruction in the ureter or urethra, necrosis, ulceration, encrustation, stone formation, infiltration of the bladder wall, and infection.

Painless hematuria is usually the first and only symptom, occurring in 90 per cent of cases. It is generally intermittent, and cys-

toscopy should be undertaken at a time when the bleeding has stopped in order that the tumor may more easily be identified. Treatment depends on the nature and location of the tumor. Excision or resection does not relieve the condition, and in some cases aggravates the symptoms, there being superadded implantations and metastasis.

Radium in the form of radon seeds, used in conjunction with other methods of treatment, has proved satisfactory. High frequency current through the cystoscope, or by suprapubic operation, has worked well in apparently hopeless cases, and for benign growths fulguration with the bipolar high frequency current is the treatment of choice. Deep X-ray therapy can be used successfully as an adjuvant to other types of treatment, and relieves pain.

The mortality rate for all types of carcinomatous tumors of the bladder was 75 per cent; in cases of malignant papilloma it was 12 per cent, and in cases of benign papilloma there were no deaths.

BLOOD CHANGES

Blood Sugar Changes after Irradiation of the Suprarenal Regions. Cherigie, Langeron, and Desplats. *La Presse Méd.*, April 11, 1931, XXXIX, 526.

The blood sugar level is lowered by irradiation of the suprarenals, both in normal persons and in diabetics, but in the latter the reduction is very much greater. Four doses of 1,000 R (Solomon) were given to each suprarenal region, and the fall in blood sugar commenced soon after the application of the first dose.

WALTER M. LEVITT, M.B., M.R.C.P., D.M.R.E.

Blood Studies in Cases Receiving Protracted Fractional X-ray Treatment. Walther Gloor and Adolf Zuppinger. *Strahlentherapie*, 1931, XL, 438-464.

In eleven cases of malignant tumors, blood examinations were carried out regularly while the patient received X-ray therapy, according to the protracted fractional method (Coutard). The red blood picture showed variations dur-

ing the treatment, but recovered quickly after the last exposure. The qualitative changes were very small. The variations in the leukocyte count differed depending upon the presence of mucous membranes, with squamous epithelium in the irradiated area. As a rule, there was a slight initial leukocytosis during the second to fifth day, followed by a moderate leukopenia. As soon as the erythema started in the mucous membrane, the leukocyte drop was interrupted by a definite increase, lasting for several days. Following that increase, the number drops again and reaches its lowest level.

The variations in the leukocyte curve are mainly due to the number of neutrophil cells. The lymphocytes drop after the beginning of treatment, first quickly, then slower, to a minimum which is reached at the end of the treatment. The recovery is slow. In unfavorable cases, the lymphocyte count remains low. Monocytes, eosinophils, and plasma cells show slight and inconstant variations.

In cases which respond to the treatment, the blood returns to normal in about from two to four weeks following the treatment. The qualitative changes are not characteristic. The globulin curve runs inversely to the leukocyte curve. Comparing the blood changes with those in cases receiving one single massive dose, one gains the impression that with the protracted fractional dose method they are rather less, but certainly not more pronounced. Certain pathologic granula seen in the neutrophil cells are undoubtedly due to the resorption of decayed cells rather than to an injury of the bone marrow.

ERNST A. POHLE, M.D., Ph.D.

BONE (DIAGNOSIS)

Lead in the Growing Skeleton. Editorial. *Jour. Am. Med. Assn.*, June 6, 1931, XCVI, 1956.

It has recently been demonstrated that chronic lead poisoning, induced in childhood, may reveal itself in roentgenograms of the adolescent skeleton. Shadows appear at the growing ends of the long bones similar to those seen after continued administration of

phosphorus. The fact that lead produces such definitely recognizable changes in the bone, in process of formation, promises to have considerable diagnostic value in cases that have heretofore offered problems of considerable import. It has been shown that lead compounds can actually enter the skeleton. The fact that only those parts of the skeleton are affected which are in process of growth at the time of ingestion of the lead is proved by the entirely normal structure of the old bone proximal to the lesions, the sharp limitation of the lesions to the growing parts, and a degree of involvement at any point exactly proportional to the rate of growth at that point.

Only where growth occurs rapidly do the changes readily reach such magnitude as to show in roentgenograms. A new field of interest in relation to the dangers of the environment of childhood is thus opened.

C. G. SUTHERLAND, M.D.

Inorganic Blood Chemistry in the Osteochondritides. Joseph Buckman and Isaac F. Gittleman. *Am. Jour. Dis. Child.*, December, 1930, XL, 1250-1261.

In view of conflicting reports in the literature concerning inorganic blood studies in patients with various osteochondritides, the authors studied thoroughly forty-three cases. The material included instances of vertebral epiphysitis, osteochondritis of the vertebral body, Legg-Perthes' disease, Osgood-Schlatter's disease, Koehler's disease of the tarsal scaphoid, and cases of displaced femoral epiphysis. Several patients had multiple lesions, varying in form from mild to severe and in age from three to nineteen years. In all, determinations of calcium and phosphorus content of the serum were carried out, and in eight cases, additional potassium, magnesium, and sodium determinations were made.

No evidence of rickets in this series of osteochondritides was found, as was shown by the inorganic blood studies, and the inorganic phosphorus, calcium, sodium, potassium, and magnesium content of the serum was well within normal limits.

F. B. MANDEVILLE, M.D.

Primary Myelogenous Sarcoma Complicating Cystic Disease of the Humerus. Paul H. Harmon and Hugh McKenna. *Arch. Surg.*, June, 1931, XXII, 903.

They report a case of a woman, 65 years of age, who sustained a pathologic fracture of the humerus, which was later found to be cystic in character. This original fracture healed, and she later sustained a second pathologic fracture, the arm finally being amputated after developing changes which suggested malignancy.

On the positive evidence of bony periosteal lifting and the presence of a significant, although small, amount of stroma that could have been produced by potential osteoblasts, the diagnosis of an osteolytic myelogenous sarcoma is based. The majority of microscopic fields of sections of this tumor demonstrates a picture not inconsistent with myeloma, thus illustrating the deceptiveness of an incomplete histologic study of a malignant bone tumor. The authors consider this case as an instance of a malignant neoplasm, complicating a cystic disease of the bone.

HOWARD P. DOUB, M.D.

The Recognition of Accessory Centers of Ossification in the Transverse Processes of the Dorsal Vertebrae and the Persistence of These Centers in the Transverse Process of the First Dorsal. Gösta Gråberger. *Acta Radiologica*, 1931, XII, Fasc. 1, No. 65, pp. 77-84.

The author discusses the varying opinions of anatomists concerning the time of appearance and union of the centers of ossification in the transverse processes of the dorsal vertebrae, particularly the first. He has examined 200 patients between the ages of 10 and 20 years, and concludes that the accessory centers appear in the transverse processes between the ages of 11 and 14 years and are completely united, as a rule, between the ages of 18 and 20 years. He finds, however, that these accessory centers in the transverse processes of the first dorsal sometimes persist in later life.

The author has gone through the chest and spine films of 3,000 persons over 20 years of

age. Twenty-two of these (0.7 per cent) showed persistence of the accessory centers of the transverse processes of the first dorsal. There was unilateral persistence in the right side in 9 individuals (0.3 per cent), unilateral persistence in the left side in 6 (0.2 per cent), and bilateral in 7 (0.2 per cent). None of these cases had any symptoms and none of them presented any history of injury. The author believes that the condition is probably due to mechanical factors, such as deflection of the transverse processes upward or downward, scoliosis, muscular attachments, and vascular anomalies.

A. L. HART, M.D.

Flat Vertebrae (Platyspondylia: Presenile Osteoporosis). Franz Polgár. Röntgenpraxis, April 15, 1931, III, 346-357.

When a vertebra has decreased regularly and markedly in height, one may call it a "flat vertebra." The congenital and acquired types are not yet sufficiently known. A rare case of "microspondylia," or platyspondylia, is described in detail, and the difficulty of differentiating it from vertebra plana Calvé is emphasized. In this group are also described certain types of Kümmell's disease and the vertebra plana Calvé. The flat vertebra may also be seen in the primary presenile osteoporosis; however, this usually leads to an hourglass-like deformity of the vertebra. The clinical picture is not well known and the etiology is not clear. The author suggests the name "kyphosis præsenilis osteoporotica."

H. W. HEFKE, M.D.

Fractures of the Posterior Tubercle of the Astragalus and of the Os Trigonum: A Clinical and Anatomical Study. Giuseppe Rotolo. Clin. Chirurg., December, 1930, XXXIII, 1375-1405.

In order to throw some light on the differentiation of Shepherd's fracture (fracture of the external posterior tubercle of the astragalus) from the os trigonum, the author reports, with radiographs, eight cases of fracture of the posterior tubercle of the astragalus and

four cases of os trigonum (2 bilateral and 2 unilateral), in two of which the latter had been fractured. These occurred among more than 200 cases of fractured arch of the foot and of the posterior tarsus, which leads the author to state that Shepherd's fracture occurs more frequently than does os trigonum. He also reports some studies carried out on a cadaver concerning the anatomy of the posterior calcaneo-astragaloid ligament.

The article is illustrated by thirty-one radiographs.

E. T. LEDDY, M.D.

A Peculiar, Apparently Hitherto Undescribed, Disease of the Long Bones of the Hand and Foot. H. Bergstrand. Acta Radiologica, 1930, XI, 596-612.

The author describes two cases of a disease involving the long bones of the hand or foot, both of which showed roentgenologic changes, suggesting osteogenic sarcoma, and both of which were operated upon with final complete recovery.

One of these patients was a 16-year-old girl, the other an 18-year-old boy. In neither case was there any history of a previous injury of which the patient was conscious. Each showed in the bone involved an irregular thickening, with the cortex showing through distinctly. One case revealed, in addition, irregular rarefaction and spicules along the border.

The author describes in detail the histologic findings in the tissue removed from both patients. The bone marrow and the blood-forming cells were completely absent. He believes the origin of these conditions lies in a disturbance of bone formation during embryonal life.

ALAN L. HART, M.D.

Spondylolisthesis, with Special Reference to the Industrial Case. J. Edgar Stewart. Southern Med. Jour., April, 1931, XXIV, 317-321.

The author describes the pathologic anat-

omy, incidence, and clinical picture of this condition. The conclusive evidence is in the radiologic examination, and without radiograms the existence of the displacement can only be guessed at. Any patient complaining of a low-back disability or who has sustained an injury to the back should have roentgenograms in two planes, this being just as important in this region as about the extremity joints. The importance of the X-ray examination at a later date, when the examination following the injury was negative, is very strikingly shown by cases cited. The fifth lumbar vertebra will frequently be shown to have slipped forward some days or weeks following an injury, when nothing was visible on films made at the time.

W. W. WATKINS, M.D.

BONE (THERAPY)

Studies on Fractures of the Upper Extremity of the Humerus. Theod. Johner. Schweiz. med. Wchnschr., March 21, 1931, LXI, 267-277.

Of 133 fractures of the humerus, 57, or 43 per cent, involved the upper extremity; 42, or 32 per cent, the shaft, and 34, or 25 per cent, the lower extremity. Fractures of the upper extremity of the humerus comprised 3 per cent of all fractures. They may be classified as supra- or infra-tuberculous, the former being very rare. No isolated fracture of the anatomical neck was found in this series, although in five cases it was associated with other lesions. In a series of 52 fractures of the upper extremity, 29, or more than one-half, were sub-tuberculous, and 17, or one-third, peri-tuberculous.

The author gives in tabulation form the type of trauma productive of each lesion, the resulting initial deformity as visualized in the roentgenogram, and the age distribution. He then discusses in detail the methods of treatment.

H. C. OCHSNER, M.D.

Bone Metastasis in a Case of Hypertrophic Pulmonary Osteo-arthritis. Axel

Renander. Acta Radiologica, 1931, XII, Fasc. 1, No. 65, pp. 29-40.

The author describes a case of hypertrophic pulmonary osteo-arthritis in a 48-year-old man who presented changes in several of the long bones. The left femur showed marked thickening and lamellation of the periosteum, which was, for the most part, distinctly divided from the cortex. There was rarefaction in the periosteal layer in the upper part of the femur, a similar condition being found in the central part of the bone. Some expansion of the periosteum over the rarefactions was noted, as well as similar changes in the other femur, tibia, fibula, humerus, and ulna, with a periosteal proliferation in the metacarpals and phalanges. The skull appeared normal.

The chest showed diffuse cloudiness in the middle and lower portions of the left lung field and infiltration, extending downward from the apex on the right. There was a small pleural exudate on the left. The lung condition was considered to be bronchiectasis, on a tuberculous basis, and the bone changes were regarded as secondary hypertrophic pulmonary osteo-arthritis.

One of the areas in the femur was excised. The pathologic report was: A cellular tissue resembling sarcoma which enclosed decalcified bone. There were also collections of epithelial cells resembling tubular glands, which were suggestive of metastatic carcinoma. The patient died of a gradually progressing cachexia in about two months.

The autopsy showed a malignant adenocarcinoma of the adrenal, with metastases to the left lung and the bones, while in the right lung and pleura there was evidence of typical caseous tuberculosis. The bony metastases were localized to the cortex of the bones and the periosteal deposits, instead of the marrow cavity, as is usual.

The author believes that the unusual localization of the bone metastases was due to the unusual vascularization in the periosteum produced by the inflammatory process therein. He also believes that the reason the bone metastases, in this case, were not more destructive, was probably the heightened function of the periosteum due to the chronic periostitis.

A. L. HART, M.D.

Disruption of Pelvis, with Luxation of the Innominate Bone. C. W. Peabody. *Arch. Surg.*, December, 1930, XXI, 971.

The author reports eight cases with separation and displacement of the entire, or nearly the entire, innominate bone. In five of these cases there was separation of the symphysis pubis, and also the sacro-iliac joint. In the remaining cases, there were fractures through the pubic arch, with separation and displacement of the sacro-iliac joint on the same side. One of these patients died, one was not traced, and the rest made a complete recovery. On going over the literature, the author found this to be a rather uncommon condition, with a serious outlook.

In this series the author used a method of reduction which is somewhat different from methods previously reported. As soon as the general condition warranted the use of an anesthetic, the patient was moved to the X-ray department and was placed on a tilting fluoroscopic table. The foot on the affected side was fastened firmly to the head of the table, and the table was then tilted upwards, almost to the vertical position, so that the weight of the body was almost entirely on the affected leg. Under fluoroscopic control, the pelvis was then manipulated until replacement could be seen as well as felt. A special webbing belt was then placed around the pelvis and buckled in place. The table was then returned to the horizontal position, the traction released, and the position again checked by the fluoroscope. The patient was then returned to his room on the Bradford frame, to the end of which his foot was re-attached, and the head end inclined downward. Twenty pounds of traction was maintained on the leg of the affected side. The binder was replaced by an overhead pelvic sling after return to the fracture bed. In two cases a recurrence of some of the rotation displacement at the symphysis occurred at the second month, which was due to moving the patient. In both instances operation with wiring of the symphysis pubis was then done.

In the six cases treated, all the patients recovered without any residual disability referable to the pelvic injury. In all cases, the

upward displacement of one side of the pelvis was corrected, and consolidation of the pelvic ring was obtained. In two cases, the relation at the symphysis was not entirely normal, and anatomic reposition at the point of fracture was not obtained.

HOWARD P. DOUB, M.D.

BONE DISEASES (DIAGNOSIS)

A Case of Arthropathy of the Shoulder with Syringomyelia. Hans Fritsch. *Röntgenpraxis*, April 15, 1931, III, 373, 374.

A case of syringomyelia is described, in which the head of the humerus was found to be entirely absent. The changes probably existed for many years previous to their detection, without causing symptoms, because of the anesthesia produced by the syringomyelia.

H. W. HEFKE, M.D.

III.—Correlation of the Roentgenologic Picture with the Gross and the Microscopic Examination of Pathologic Material in Congenital Osseous Syphilis. Stafford McLean. *Am. Jour. Dis. Child.*, March, 1931, XLI, 607-675.

This is the third paper of a series by the author on congenital osseous syphilis, in which the charts of sixteen syphilitic infants who came to autopsy are presented. In each of the sixteen cases evidence of pathologic changes in the bones was noted on the X-ray film. In all but two instances, the bone removed at autopsy for microscopic examination was selected because it presented the most marked evidence of the disease on the X-ray films. The bones of the lower extremities were used when possible, as they were more suitable for a microscopic comparative study. The specimens ranged from the earliest to the most advanced type of osteochondritis at the epiphyso-diaphyseal junction. The diaphyseal lesions ranged from slight cortical changes to well-marked symmetrical osteomyelitic lesions, involving a large area of the shaft. Periosteal changes and nearly every variety of pathologic

omy, incidence, and clinical picture of this condition. The conclusive evidence is in the radiologic examination, and without radiograms the existence of the displacement can only be guessed at. Any patient complaining of a low-back disability or who has sustained an injury to the back should have roentgenograms in two planes, this being just as important in this region as about the extremity joints. The importance of the X-ray examination at a later date, when the examination following the injury was negative, is very strikingly shown by cases cited. The fifth lumbar vertebra will frequently be shown to have slipped forward some days or weeks following an injury, when nothing was visible on films made at the time.

W. W. WATKINS, M.D.

BONE (THERAPY)

Studies on Fractures of the Upper Extremity of the Humerus. Theod. Johner. Schweiz. med. Wchnschr., March 21, 1931, LXI, 267-277.

Of 133 fractures of the humerus, 57, or 43 per cent, involved the upper extremity; 42, or 32 per cent, the shaft, and 34, or 25 per cent, the lower extremity. Fractures of the upper extremity of the humerus comprised 3 per cent of all fractures. They may be classified as supra- or infra-tuberculous, the former being very rare. No isolated fracture of the anatomical neck was found in this series, although in five cases it was associated with other lesions. In a series of 52 fractures of the upper extremity, 29, or more than one-half, were sub-tuberculous, and 17, or one-third, peri-tuberculous.

The author gives in tabulation form the type of trauma productive of each lesion, the resulting initial deformity as visualized in the roentgenogram, and the age distribution. He then discusses in detail the methods of treatment.

H. C. OCHSNER, M.D.

Bone Metastasis in a Case of Hypertrophic Pulmonary Osteo-arthropathy. Axel

Renander. Acta Radiologica, 1931, XII, Fasc. 1, No. 65, pp. 29-40.

The author describes a case of hypertrophic pulmonary osteo-arthropathy in a 48-year-old man who presented changes in several of the long bones. The left femur showed marked thickening and lamellation of the periosteum, which was, for the most part, distinctly divided from the cortex. There was rarefaction in the periosteal layer in the upper part of the femur, a similar condition being found in the central part of the bone. Some expansion of the periosteum over the rarefactions was noted, as well as similar changes in the other femur, tibia, fibula, humerus, and ulna, with a periosteal proliferation in the metacarpals and phalanges. The skull appeared normal.

The chest showed diffuse cloudiness in the middle and lower portions of the left lung field and infiltration, extending downward from the apex on the right. There was a small pleural exudate on the left. The lung condition was considered to be bronchiectasis, on a tuberculous basis, and the bone changes were regarded as secondary hypertrophic pulmonary osteo-arthropathy.

One of the areas in the femur was excised. The pathologic report was: A cellular tissue resembling sarcoma which enclosed decalcified bone. There were also collections of epithelial cells resembling tubular glands, which were suggestive of metastatic carcinoma. The patient died of a gradually progressing cachexia in about two months.

The autopsy showed a malignant adenocarcinoma of the adrenal, with metastases to the left lung and the bones, while in the right lung and pleura there was evidence of typical caseous tuberculosis. The bony metastases were localized to the cortex of the bones and the periosteal deposits, instead of the marrow cavity, as is usual.

The author believes that the unusual localization of the bone metastases was due to the unusual vascularization in the periosteum produced by the inflammatory process therein. He also believes that the reason the bone metastases, in this case, were not more destructive, was probably the heightened function of the periosteum due to the chronic periostitis.

A. L. HART, M.D.

Radiologica, 1931, XII, Fasc. 1, No. 65, pp. 59-76.

The authors describe the physical characteristics and the roentgen examinations of two cases of achondroplasia: one, a man of 47 years, the other, a boy of 16 years. Both exhibited many of the usual features of this type of dwarfism. The first case also presented a definite familial inheritance of dwarfism. There is an extensive discussion of the Continental literature on the possible causes of this condition.

The opinion of the authors is that achondroplasia is due to pituitary dysfunction. One of their cases had no sella in the roentgen films, and the other had a small deformed sella.

A. L. HART, M.D.

Shadows Produced by Lead in the X-ray Pictures of the Growing Skeleton. Edwards A. Park, Deborah Jackson, and Laslo Kajdi. *Am. Jour. Dis. Child.*, March, 1931, **XLI**, 485-499.

The authors note that lead, when taken for a sufficiently long period in sufficient dosage, can apparently produce changes in the bone in process of formation, which are reflected in roentgenograms as shadows of increased density. The clouding is most conspicuous where growth is occurring most rapidly, namely, at the anterior ends of the middle six ribs, the lower ends of the femora, the upper end of the humerus, the lower ends of the radius and ulna, and at both ends of the fibula and tibia. The fact that only bone in process of growth is affected must mean that the lead either enters into the chemical composition of the bone or influences cellular activity in such a way that the character of the bone formed becomes altered. Several studies bring forward strong indirect evidence that the place of deposit is the trabeculae, lying in close proximity to the cartilage. From a study by the authors of two autopsy cases, they suppose that the lead modified the endochondral ossification in such a way that the trabeculae formed under the cartilage a much denser thickening than normally, and that these formations of densely packed trabeculae were the cause of the band-

like shadows. They admit, however, the probability that lead itself was in the trabeculae and may have been partly responsible for the shadows. In the four cases roentgenographed, band-like shadows were noted in all of them.

F. B. MANDEVILLE, M.D.

Joint and Bone Changes in Hemophilia. Erich Forfota. *Röntgenpraxis*, May 1, 1931, **III**, 399.

One of the symptoms of hemophilia is the characteristic change in the joints and bones caused by repeated hemophilic hemorrhages. The changes seen roentgenologically are numerous and varied. Two cases are described in detail. X-ray examination of the knees in the first case showed atrophy of the bones, narrowing of the joint spaces, well-circumscribed areas of bone destruction (cysts), and arthritic spurs. Similar changes were also seen in the right elbow. The second patient showed the identical picture in both knees and elbows. Examination of the pelvis revealed multiple large cystic areas in the right ilium. Fourteen years previously the patient had had a severe hemorrhage in the region of the right hip. At the time of examination there was a large palpable tumor in the pelvis, which contained liquid blood. These atypical bone changes can best be explained by erosion of the bone by large hemorrhages which have persisted over a long period of time.

H. W. HEFKE, M.D.

A Case of Monoarticular Chondromatosis of the Skeleton. Robert Kienböck. *Röntgenpraxis*, May 1, 1931, **III**, 406.

There are cases of chondromatosis of the bones in which a single region of the body, especially a joint region, is attacked by multiple tumors of the same kind, namely, monoarticular chondromatosis. Such cases may be classified between the solitary tumors and the generalized or unilateral disease of the skeleton. Even if the tumors grow enormously large, a lasting arrest in the growth may take place, a fact which is important for prognosis and therapy. In the case described, an interval of fifteen years showed no progress in the

change of the bone in congenital syphilis of the first few months of life are demonstrated. The study of the roentgenograms, in conjunction with the pathologic material, has made quite clear and simple the explanation of changes in the bone seen by the X-ray films, which formerly were obscure.

F. B. MANDEVILLE, M.D.

IV.—The Correlation of the Clinical Picture with the Osseous Lesions of Congenital Syphilis as Shown by the X-rays. Stafford McLean. *Am. Jour. Dis. Child.*, April and May, 1931, **XLI**, 887-922 and 1128-1171.

This paper concludes a series of four articles by the author on the osseous lesions of congenital syphilis. The case reports and roentgenograms of 45 infants from 28 days to 22 months of age are included, with the case reports arranged according to age. In two cases, the roentgenogram revealed the diagnosis before a positive serologic reaction had been obtained.

The different varieties of lesions of certain bones, particularly the tibia, are illustrated and the selectivity of the disease for certain parts of the bones and for certain bones, as well as the curious selectivity in the onset of healing, are brought out by the author.

The type of lesion that by the X-rays simulates rickets and the type simulating scurvy are illustrated. The evolution of the osseous lesions and the relationship and disrelationship between cutaneous and visceral manifestations and osseous lesions are discussed.

The different types of saw-tooth metaphyses and various examples of "epiphyseal separation" are shown.

F. B. MANDEVILLE, M.D.

A Study of Bone Tumors in Ex-service Men. Philip B. Matz. *United States Vet. Bureau Med. Bull.*, April, 1931, **VII**, 321-336.

The author analyzes 45 cases of bone tumors occurring in ex-service men. In this series 38, or 84.5 per cent, were cases of osteogenic sarcoma; 5, or 11.1 per cent, were benign giant-

cell tumors; one case was an unclassified sarcoma, and one case was a benign osteogenic tumor. The question of hereditary susceptibility was also studied and in no case was there a positive family history of either malignancy or sarcoma. It was found that in 13, or 28.9 per cent, a positive history of trauma was obtained and that the period of time intervening between the trauma and the first symptoms of this condition varied from less than one month to forty months. The average age of the 45 cases at the time of diagnosis was 24.7 years. The average age of the 13 living cases was 37 years, while that of the group that died was 27.4 years.

The lower end of the femur and the upper extremity of the tibia were the most common locations of the involvement of this condition. Metastases were present in 55.6 per cent of the 45 cases. The highest incidence of metastases was noted among the mixed-cell type of osteogenic sarcoma. In reviewing the diagnostic symptoms and signs of bone tumors as recorded in the histories, it was noted that pain, swelling, and loss of function were the most frequently observed. In 19 instances the roentgenogram was suggestive of bone tumor, while in the remaining 26 cases of the series there was no record of a roentgenologic examination.

In the treatment of the 38 cases of osteogenic sarcoma, amputation was the surgical procedure in 28 instances and of this number 5 patients are alive. Other surgical procedures included disarticulation, resection of the bone, excision of the tumor, and curettement. Two patients with osteogenic sarcoma received either X-ray or radium only, and both of these patients are dead. Sixteen cases of osteogenic sarcoma received X-ray or radium or both in addition to undergoing surgical operation, and of this number, two are alive. One case that received Coley's toxins only is dead, and two that received Coley's toxins, in addition to surgical treatment, are alive.

J. N. ANÉ, M.D.

Two Cases of Achondroplasia. N. Mesz, J. Fliederbaum, and R. Markuszewicz. *Acta*

of generalized carcinomatosis within three months' time. The other, having lived two years after treatment by radium implantation and deep X-ray, finally died in uremia, following an operation for hernia without clinical or palpatory evidence of carcinoma.

In the discussion of the paper by Dr. J. D. Barney, Dr. G. G. Smith, and Dr. C. H. De T. Shivers, the consensus of opinion regarding carcinoma of the penis was that partial or complete surgical amputation with gland resection was advisable, except in the very earliest of cases. That the deeper lymphatics might be involved, even if the more superficial inguinal glands were negative, was one of the possible complications to consider in contemplating extensive surgery.

Dr. Barney stated that in 85 per cent of reported cases of carcinoma of the penis, phimosis of long duration had been present. No individual who had been circumcised in infancy or early childhood had ever been known to develop carcinoma of the penis.

Dr. G. G. Smith emphasized the singular lack of local recurrence, and in cases which one was unable to keep under constant close observation, he felt safe in advocating amputation about half way down the shaft, with dissection of both groins.

Dr. C. H. De T. Shivers advised thorough dissection of the inguinal glands not only in advanced cases but believed the best results to be obtained by carrying out this procedure, even in early cases. He felt that amputation from two to three centimeters beyond the lesion was sufficient to prevent local recurrence. The Doctor preferred to depend upon radical dissection rather than radium or X-ray treatment to effect a cure.

DAVIS H. PARDOLL, M.D.

Carcinoma of the Penis. Fletcher H. Colby and George G. Smith. *Jour. Urol.*, May, 1931, XXV, 461-467.

The authors have attempted to correlate the clinical course of carcinoma of the penis and the histological aspect. They conclude, from a series of 50 cases, that there exists a definite correlation between the grade of malignancy and the clinical course in carcinoma of the

penis. Their evidence is based on the fact that a greater percentage of the cases of low malignancy have lived for a longer period of time following operation than cases of high malignancy. In addition, there appears to be less tendency for the cases of low malignancy to involve the regional lymph nodes. Dissection of the groin is usually found to be advisable, except in the earliest cases. The latter are amenable to more conservative surgical measures or radiation, with a reasonable expectation of cure. Phimosis was present in nearly 50 per cent of the cases and might be regarded as possessing some relationship to the development of cancer in this region. The average age was fifty-nine years, the youngest patient being thirty-nine and the oldest ninety. One-third of the patients were between the ages of forty and fifty.

DAVIS H. PARDOLL, M.D.

Mammary Cancer. Charles A. Vance. *Southern Med. Jour.*, February, 1931, XXIV, 112-114.

The prognosis in mammary cancer depends upon the length of time the disease has existed when the patient comes to operation, the thoroughness of the operative procedure, and, perhaps, the virulence of the disease. Theoretically, if the diagnosis is made prior to the occurrence of metastases to glands or elsewhere, and radical operation is performed at once, there should be no recurrences and no deaths. In every case of mammary cancer, careful X-ray examination of the chest and long bones should be made, as metastases sometimes occur very early. There is yet no consensus of opinion in regard to either pre-operative or post-operative X-ray therapy. The author's personal feeling is that X-ray is beneficial when used both before and after radical operation.

W. W. WATKINS, M.D.

Primary Carcinoma of the Lungs. IV.—Intracranial Metastases. B. M. Fried and R. C. Buckley. *Arch. Path.*, February, 1930, IX, 483-527.

Metastases to the central nervous system

size of the growth, which had attacked the humerus, radius, and ulna near the elbow joint. One can usually make a diagnosis with certainty, and can differentiate it from malignant sarcoma and benign osteitis fibrosa cystica.

H. W. HEFKE, M.D.

Staphylococcus Albus Septicemia with Osteomyelitis of the Pubic Bone. Lee Bivings. *Am. Jour. Dis. Child.*, December, 1930, XL, 1262-1268.

Septicemias caused by *Staphylococcus albus* are rather uncommon. They are usually accompanied by numerous complications in the form of metastatic abscesses, and frequently terminate fatally. Osteomyelitis of the pubic bone from any cause is rare. McWhorter has reviewed ten cases, four of which were his own. One patient died, but the others survived after complicated and protracted illness.

The author reports a case of a boy, seven years of age, who was infected with *Staphylococcus albus*, following the crushing of a furuncle on his knee. Roentgenograms demonstrated an osteomyelitis of the ascending and descending rami of the right pubic bone, and the progress of the condition is shown in a series of films. Metaphen was given intravenously every eight hours for seven times, the dosage begun with 5 c.c. of a 1:1,000 solution and gradually increased to 10 cubic centimeters. It was interesting to note that the white cell count continued to climb daily as metaphen was given, and that it began to fall immediately after this drug was discontinued. No conclusions as to the efficacy of this treatment were drawn from this one case.

F. B. MANDEVILLE, M.D.

Streptococcal Infections of the Epiphyses and Short Bones: Their Relation to Köhler's Disease of the Tarsal Navicular, Legg-Perthes' Disease, and Kienböck's Disease of the Lunatum. D. B. Phemister, Alexander Brunswick, and Lois Day. *Jour. Am. Med. Assn.*, Oct. 4, 1930, XCV, 995.

Bacterial studies have been undertaken in a

group of obscure but kindred necrosing bone lesions, among which are Köhler's disease of the tarsal navicular, Legg-Perthes' disease, and Kienböck's disease of the carpal semilunar, in an endeavor to throw some light on their etiology. The most feasible causes to which they have been attributed may be grouped under the headings of infection, embolism, and trauma. Axhausen considers the condition an anemic infarction from a mycotic embolus or a thrombus, but without bacterial infection of the field.

In the few cases in which cultures have been made, they have usually been reported as sterile. In this series, cultures were taken in two cases, each of Köhler's disease of the tarsal navicular bones, Legg-Perthes' disease, and Kienböck's disease of the lunatum. Streptococci grew in the cultures of four cases: one of Köhler's disease, one of Legg-Perthes' disease, and two of Kienböck's malacia. In one case of Köhler's disease in a child with multiple osseous and glandular tuberculosis, the cultures were sterile and guinea-pig inoculations were negative for tuberculosis. The cases are discussed in detail.

The authors' observations suggest that streptococci play an important rôle in the etiology of these diseases but that other factors bring them about. Whether the streptococci reach the bone in an embolus which blocks the main artery or whether they lodge there alone remains undetermined.

CHARLES G. SUTHERLAND, M.D.

CANCER (DIAGNOSIS)

Sinus Tract Carcinoma. Ernest M. Watson. *Jour. Urol.*, May, 1931, XXV, 469-486.

The author reports two cases of primary carcinoma in suprapubic sinuses, which followed many years after suprapubic cystotomy for urethral stricture. The strictures were of traumatic and gonorrheal origin, respectively. Secondary infection had been present for several years and, undoubtedly, might have played a part in the production of the carcinomatous condition. In one case treated by excision, radium, and deep X-ray, the patient died

ing the histologic grade and primary site. It was found that the histologic grading agrees with the clinical prognosis, and that there was a direct correlation between the grade and the interval between the patient's first symptom and his seeking of advice, as the delay in seeking advice is usually inversely proportional to the rate of growth. The prognosis of operative growths also shows a direct correlation with the prospect of cure. The percentage of three-year cures in each grade was as follows: (1) 34.8, (2) 29.3, (3) 16.3, and (4) 5.9 per cent; for five years, grade (1) 33.3, (2) 23.7, (3) 10.3, and (4) 0.

Tabulations are given showing the criteria of grading with regard to the number of cell-nests, keratinized cells, squamous cells, prickle cells, mitoses, etc., for the relation of the primary site of the histologic grade, for the relationship between histologic classification and clinical course, and for the effect of irradiation upon primary carcinoma, according to its histologic grade. There is also a tabulation showing the response of the primary lesion to irradiation, according to the degree of round-cell infiltration. No relationship was found between the reaction of the primary growth to irradiation and the degree of round-cell infiltration of the stroma. Of all the grades treated by irradiation 45.1 per cent are shown as healed, and by grades as follows: (1) 50 per cent, (2) 40 per cent, (3) 40 per cent, and (4) 61.5 per cent. In the few cases that the author has been able to observe, the changes in the epithelioma following irradiation have shown in a striking manner the rapid differentiation of the malignant cells into keratinized cells; these latter die and are absorbed by polymorphonuclear phagocytosis. Two cases in which the lymphatic glands containing metastases were excised after the irradiation showed that the metastases were of a lower histological grade than the primary growth, i.e., had undergone greater differentiation.

Thus the action of irradiation may be summarized as follows: (1) The actively dividing cells (the embryonic types) are destroyed by direct action. (2) The differentiating, more adult type of cell is speeded up at the differentiation, becomes keratinized, and so

dies—that is, it is destroyed by indirect action. From this, he considers the practical application of his findings to be as follows: The best method of irradiation is the one adapted to the histology of the cancer under treatment—with Grade 1, small doses acting for a long time. For Grades 2 and 3, a moderate intensity over a moderate time is suggested, or perhaps a combined X-irradiation with radium, and for Grade 4, a high intensity for a short time.

H. J. ULLMANN, M.D.

Eleven Years' Experience with Radium Treatment of Carcinoma of the Cervix at the Woman's Hospital: Statistical Report. G. G. Ward and L. K. P. Farrar. Surg., Gynec. and Obst., February, 1931, LII, No. 2A, pp. 556-559. (Reprinted by permission from British Med. Jour., May 9, 1931, No. 3,670, p. 89 of Epitome of Current Medical Literature.)

The authors, reporting a series of 251 cases of cervical carcinoma treated with radium, remark that the leukopenia induced by this therapeutic method necessitates steps being taken to fortify the patient's resistance against septic infection, and so against the unpleasant sequels that may otherwise be associated with the absorption of the post-radiation slough. Each case is carefully examined at monthly intervals after radiation, in order to detect signs of early recurrence in the form of small nodules or erosions, and also to deal with the possible complication of pyometra in its first stages. The authors conclude, as the result of their eleven years' experience, that in carcinoma of the cervix the best results can be obtained by employing the smaller dosages of radium (2,400 to 4,200 mg.-hrs.), provided that the cases are re-examined at frequent intervals during the subsequent five years, and that recurrences are dealt with at once by renewed radiation. Any cachexia or anemia should always be treated in advance by blood transfusion if the red corpuscles have fallen below 3,500,000 per c.mm. and the hemoglobin percentage below 50.

The authors hope that high voltage X-ray

were found in fifteen of thirty-seven cases with bronchiogenic cancer. For eleven of the fifteen cases, a diagnosis of primary tumor of the brain was made, and the bronchiogenic tumor was overlooked.

It is believed that when a person of middle age has an abrupt onset of symptoms and signs of a rapidly developing intracranial lesion, a metastatic cerebral lesion should be thought of, the lungs being the most common site of the primary lesion. It is realized, moreover, that even in instances in which the examination of the lungs yields negative results, the presence of a primary tumor in these organs cannot be excluded.

The authors believe that metastases occur by way of the blood stream.

A. O. HAMPTON, M.D.

CANCER (THERAPY)

Histology of Buccal Carcinoma in Relation to Prognosis and Radiosensitivity. Ralph Phillips. *Lancet*, Jan. 17, 1931, CCXX, 118.

Many pathologists consider that the explanation of radiosensitivity and radioresistance is to be found in the histology of the cancer cell. The present paper is an attempt to find a histological explanation of the fact that local healing of carcinoma of the tongue is obtained in less than half the cases treated by irradiation.

In order to have a firm background for the work, it was first necessary to prove a relationship between the histology of the tumor and its clinical course. If it is possible to classify, with some constancy, the degree of histological differentiation in a carcinoma, it might perhaps be expected that such a classification would be correlated with events such as the following: (1) The rate of growth of the tumor; (2) the duration of life from the detection of the growth; (3) the tendency to dissemination; (4) the time of appearance of metastases; (5) the results of operative treatment; (6) the reaction to radiotherapy.

The life-history of the malignant cell is then discussed, with the relationship of the rapidity of growth of the tumor and the degree of differentiation and specialization. The author

discusses Broders' classification and quotes Ewing as stating that the idea of dedifferentiation is an unwarranted assumption and contrary to sound biological principle. Another criticism of Broders' classification is that a malignant growth is not uniform in structure throughout, and that, therefore, no single histologic section is of value as an index of malignancy. The author specially investigated this point, and found that such a contention was completely untrue, at least for buccal carcinomas. Several growths were sectioned serially, and in many, two sections from different parts of the growth were taken. In every case uniformity of the growth was found, and further, the lymph gland metastases were in nearly every case uniform in structure with the primary growth. He considers it remarkable that the structure of a carcinoma is so rigid that its metastases reproduce not only its coarsest but even its finest histologic characteristics.

The material investigated consisted of all the cases of carcinoma of the lip, tongue, floor of mouth, tonsil, and palate treated in St. Bartholomew's Hospital, between 1921 and 1927, so that three years at least have elapsed for the estimation of results. In addition, cases treated by irradiation in the years 1928 and 1929 were studied from the point of view of healing of the primary lesions. All the available histologic sections were collected and graded according to Broders. The same was then done independently for the lymph glands, where these had been removed and sectioned, and, lastly, the clinical notes of the patients were abstracted, and cases in which no pathologic section had been taken were included for completeness. As the meaning of the stroma reaction is obscure, and conflicting views are held, it was decided to confine the investigation to the malignant cells alone. Of 319 patients, 71 were treated by radiotherapy and followed up for one year or more to discover the effect on the primary growth. Of the 248 which remained, 208 were followed up for three years or more. Out of 286 patients operated upon, 40 untraced cases and eight post-operative deaths were excluded from the follow-up results. Tabulations are given show-

tive merit of the radiation therapy amounted to 6.8 per cent in the operable and 2.4 per cent in the inoperable cases.

The number of cases of fundus cancer was 216; 176 of these (81.4 per cent) were operable and the remaining 40 (18.6 per cent) were inoperable. The absolute number of cured patients was 85 out of 216 cases, or 39.3 per cent. The figures for the relative cures were zero for the inoperable cases and 85 out of 176, or 48.3 per cent, in the operable cases. Radical operation cured 66 (48.1 per cent) out of 137 patients. Radical operation and post-operative irradiation cured 84 out of 163 cases, or 51.5 per cent. The primary mortality of the cases operated upon was 9.8 per cent.

ERNST A. POHLE, M.D., Ph.D.

CATHODE RAYS

The Effects of High Voltage Cathode Rays on the Germinal Epithelium of the Rat. Victor C. Jacobsen. *Arch. Path.*, May, 1930, IX, 967-983.

A study was made of the effects of cathode rays of high voltage on the germinal epithelium of the male adult white rat. The shaved scrotal area was exposed in front of the anodal window of the Coolidge cathode-ray tube at voltages of 200,000 and 250,000, with a current of 1 milliamperere. The length of the exposure varied from five-tenths of a second to thirty seconds. The changes in the scrotal skin were similar to those in the abdominal skin as described previously by Waddell and Jacobsen.

Doses sufficient to produce dry necrosis of the skin cause lesions in the seminiferous tubules in a zone about 0.6 mm. in depth. The lesions consisted of degenerative and necrotic changes resembling those caused by roentgen rays. The tela subcutanea, below the upper 0.2 mm. of the skin, and the tunica vaginalis testis showed no evidence of injury, indicating clearly the much greater sensitivity of germinal epithelium to this form of irradiation.

These observations are offered as further biologic evidence that the effects of roentgen rays are not due primarily to the roentgen rays but to the electrons or cathode rays set free in the tissues.

A. O. HAMPTON, M.D.

The Physics and Technic of Cathode Rays. Paul Knipping. *Strahlentherapie*, 1930, XXXV, 391.

This is an excellent brief presentation of our present knowledge of cathode rays. The author has written it in such a manner that every physician can understand it without requiring the knowledge of higher mathematics. It is recommended, therefore, for study in the original.

E. A. POHLE, M.D., Ph.D.

CHEST (DIAGNOSIS)

Post-operative Pulmonary Atelectasis. A. Lincoln Brown. *Arch. Surg.*, June, 1931, XXII, 976.

It is fairly well agreed that bronchial obstruction plus decreased aëration ability of the lung are prime causes of post-operative pulmonary atelectasis, and that the obstruction is usually due to retained tracheobronchial secretions.

The author believes that bronchial secretions, as a cause of pulmonary atelectasis, have not been given sufficient consideration. He says that whereas coughing usually expels material from the tracheobronchial tree, it may under certain conditions actually bring about the opposite result; that is, drive the material deeper. He also notes that the degree of penetration of the material into the smaller ramifications of the tracheobronchial tree is in direct proportion to the viscosity of the material in question. With extremely viscid material the large bronchi are obstructed, and as the secretion becomes less viscid, the obstruction recedes to the smaller bronchi, and, finally, if it is of watery consistency, one obtains clinically the condition which has been spoken of as "drowned lung."

He thinks that the incidence of pulmonary

therapy will prove efficacious in dealing with the 40 per cent incidence of gland involvement in the advanced cases. In all patients whose disease has progressed beyond the cervix, surgery is prohibited. Their results with radium have been fully equal to the surgical figures of successes, but without the high primary mortality and morbidity. They doubt whether the method of following radium treatment by vaginal hysterectomy and X-radiation gives results good enough to compensate for the high primary mortality of this procedure.

The Medical Care of the Cancer Patient.
Henry Jackson, Jr., and George R. Minot.
Am. Jour. Cancer, January, 1931, XV, 6-11.

The authors discuss the responsibility of the general practitioner in the prevention and care of cancer, and stress the necessity for preventive medicine in malignant disease. The importance of the general medical care of the cancer patient is emphasized. They believe that "maintenance of their health [the cancer patients'] in the best possible state by every reasonable means may indeed perhaps play a rôle in the prevention of possible recurrence and certainly can add to the sense of well being."

JOHN R. CARTY, M.D.

Statistical Contribution to Carcinoma of the Uterus and its Treatment. A. Pfleiderer.
Strahlentherapie, 1931, XL, 13.

During the last 29 years, of the 37,535 patients seen at the Women's Clinic at the University of Tübingen, 1,554, or 4.14 per cent of all cases, suffered from cancer of the uterus (1,251 in the cervix, 303 in the fundus). It was interesting to note that during the War there occurred a drop in the number of cancer patients. How much the different diet may have been responsible for this is difficult to state. A study of the heredity showed cancer in the family in 89 out of 1,045 cases (8.6 per cent). The combination of tuberculosis with cancer was also striking, being 18.1 per cent since 1923. Constitutional factors seem to be of some influence.

There was a higher percentage of cancer in women who began to menstruate late and entered the climacteric at a later age. In those with cancer of the fundus, the climacteric seems to occur later than in those with cervical cancer. A survey of the age records shows that most cervical cancers appear between the ages of 35 and 65, with a peak during recent years at from 46 to 50 years. In older women, cancer of the fundus is apparently more malignant and gives a poor prognosis. The relations between pregnancy and cancer were quite definite. In patients with cancer of the cervix, 1.6 per cent were sterile, as compared with 13.3 per cent of the patients with cancer of the fundus; 3.8 per cent of the cervix cancer cases and 28.7 per cent of the fundus cancer cases never became pregnant. A high number of pregnancies evidently predisposes to cancer of the uterus. The inoperability in cancer of the cervix amounted to 36.1 per cent, with a 6 per cent fluctuation, and for fundus cancer to 17.8 per cent, with a 19 per cent variation.

The number of inoperable cases seems to have increased since 1920. The statistics of the end-results are based on a total of 956 cases treated during the years from 1902 to 1923. Six hundred and fifteen (4.3 per cent) were operable and 341 (35.7 per cent) were inoperable. The number of absolute cures amounted to 186 patients out of 956 cases, or 19.4 per cent. The figures for relative cures were as follows: Of 615 operable patients, 181 were cured (29.4 per cent), and of 341 inoperable cases, 5, or 1.4 per cent, were cured. The results following radical operation (Freund and Wertheim) without irradiation were 132 cured out of 445, or 29.6 per cent. If the operative cases without irradiation are combined with those which received post-operative radiation therapy, these figures changed to 181 cured patients out of 553, or 32.7 per cent. The primary mortality of the radical operation was 19.1 per cent. Two hundred and one out of 339 patients who did not receive post-operative radiation therapy developed a recurrence (59.2 per cent). Ninety-five cases were irradiated following operation, and 50 of them (52.6 per cent) had a recurrence. The rela-

and the borders were smooth. A lung tumor was suspected and radiotherapy was instituted. The patient died of a tuberculous cachexia three months later. The autopsy examination revealed an enormous aneurysm of the descending aorta, which was completely filled by a large thrombotic blood clot—hence no pulsation. The aneurysm had eroded the anterior surfaces of several contiguous vertebrae.

CHARLES S. CAPP, M.D.

Pneumoconiosis: The Delayed Development of Symptoms. James A. Britton and Jerome R. Head. *Jour. Am. Med. Assn.*, June 6, 1931, XCVI, 1938-1940.

The authors report four cases of silicosis, or silicosis and tuberculosis, which developed many years after relatively short exposures. Once a man has developed symptoms while still engaged in a dusty occupation, stopping the work does not prevent the gradual steady progression of the pathologic changes.

The question raised by these cases is of great importance from the point of view of industrial hygiene and from that of the legal aspect of industrial medicine. One developed symptoms of silicosis twenty-three years after an exposure of four months; a second, ten years after an exposure of two years; a third, fourteen years after an exposure of four years; the fourth, ten years after an exposure of ten years. These instances suggest the necessity of revising the conception of the length of exposure which is necessary to produce the disease. It seems probable that after relatively short exposures sufficient dust may be deposited in the lungs to set up a progressive fibrosis, which only after many years becomes sufficiently extensive to produce symptoms.

C. G. SUTHERLAND, M.D.

Aneurysm of the Pulmonary Artery. H. R. Wahl and Raymond L. Gard. *Surg., Gynec. and Obst.*, June, 1931, LII, 1129-1135.

Because of the extreme rarity of this condition, the authors' case is reported in detail, having been observed during a period of three

years, and studied by X-ray and the electrocardiograph. The autopsy findings clear the diagnosis and explain the clinical symptoms. Clinical diagnosis of pulmonary aneurysm is very difficult, and in only one case reported was an antemortem diagnosis proved by autopsy.

The authors quote Henschen, who says the following signs are simultaneously present in pulmonary aneurysm:

"(1) Prominence of the second and third left costal cartilages, with well-defined dullness and X-ray shadow in this area;

"(2) Intense cyanosis, other signs of congestion, hemoptysis, and substernal pain;

"(3) Pulsation and well-defined thrill and murmur in the second left interspace;

"(4) Loud, superficial, rasping systolic murmur.

"(5) Right-sided cardiac hypertrophy;

"(6) Absence of dilatation or hypertrophy of the left heart [*i.e.*, apex dullness within the mid-clavicular line];

"(7) Absence of usual signs of aortic aneurysm [*viz.*, dullness to right, difference in pulse, recurrent laryngeal paralysis]."

But in the case reported there was no pulsation in the left second interspace, due to almost complete thrombosis.

Brief reports of fourteen other cases found in the literature are given.

D. S. CHILDS, M.D.

Hydatid Cyst of the Lung. Picot. *Bull. et Mém. Soc. Radiol. Méd. France*, April, 1931, XIX, 171-173.

A twenty-year-old Arab had frequent hemoptysis, and on examination sonorous râles in the right lower lung were revealed. The X-ray films showed an ovoid uniform density, two interspaces wide, in the middle of the right lung. The pre-operative diagnosis was a dermoid cyst or sarcoma. A two-stage thoracoplasty was performed, with evacuation of a hydatid cyst. On autopsy examination, a second large unsuspected hydatid cyst in the abdominal cavity was discovered.

CHARLES S. CAPP, M.D.

atelectasis is much greater following spinal anesthesia than following any form of inhalation or regional anesthesia. This may be due to the facts that (1) spinal anesthesia definitely inhibits the depth and force of respiratory movements which tend to rid the tracheobronchial tree of foreign matter or secretions; (2) the normal viscosity of the secretions of the tracheobronchial tree appears to be increased following spinal anesthesia, and (3) the patient tends to remain relatively quiet for a number of hours following spinal anesthesia.

HOWARD P. DOUB, M.D.

Chronic Bronchitis. Wendell P. Dally. United States Vet. Bureau Med. Bull., March, 1931, VII, 250, 251.

The author considers that the inhalation of dust plays a greater rôle in the etiology of pneumoconiosis than as a causative factor of chronic bronchitis. While the symptoms of the two conditions are similar, the physical signs and roentgenographic evidence in pneumoconiosis are somewhat comparable to an advanced case of tuberculosis. The roentgenogram shows definite defined areas of mottled masses throughout the lung but especially in the hilus region. In chronic bronchitis, with the exception of an increase of fibrotic striations, and in old emphysematous cases, the roentgenogram shows little or no change from the normal.

The symptoms of chronic bronchitis vary from no respiratory distress to extreme embarrassment, with distressing paroxysms of coughing. The morbid anatomy may vary from a mild chronic passive congestion of one or more lobes to definite fibrotic changes involving practically the entire peribronchial structure. Usually the bronchial tubes are more or less dilated and the mucous membranes congested, and in later stages numerous areas of bronchiectatic cavitation exist. As a result of long continued coughing, the lung structure loses its elasticity and the constant over-supply of residual air gradually dilates the air-cells, so that eventually fibrosis and emphysema are seen.

The author urges caution, especially in the

earlier cases of chronic bronchitis, as there is ever the possibility that one may be dealing with a definite tuberculous infection. Inspection, palpation, and percussion in the early case of chronic bronchitis are of little or no help. When auscultation reveals roughened or exaggerated breath sounds, which are general throughout the chest, one may diagnose a mild degree of chronic bronchitis.

The treatment of chronic bronchitis is directed toward general measures, as removal of foci of infection, proper ventilation, breathing exercises, tonics, air baths, and sun baths. Sedatives and expectorants should be employed when indicated. In rather old cases in which bronchiectasis is in evidence, the application of lipiodol has given beneficial results.

J. N. ANÉ, M.D.

Roentgenographic Examination of the Chest, with Case Reports. Marjorie Wulff and J. Arthur Myers. Med. Jour. and Rec., Dec. 3, 1930, CXXXII, 527-529.

Two types of cases are discussed: (1) Those that have mild symptoms from time to time, but in which no evidence of pathology can be detected, except definite calcium deposits in the region of the lung hili, with or without accompanying Ghon tubercles. (2) The second group has the same findings, but in the family there is tuberculous infection which has spread to nearly all members and one or more clinical cases of tuberculosis has appeared. The chest findings in these two groups warrant far more consideration than they have received.

W. W. WATKINS, M.D.

Aneurysm of the Descending Aorta Simulating Lung Tumor. Clerc, Haret, and Fraïn. Bull. et Mém. Soc. Radiol. Méd. France, April, 1931, XIX, 164-167.

Preliminary X-ray films and fluoroscopic examination revealed a large mass in the lung, extending slightly to the right but mainly to the left of the cardiac borders in the region of the left auricle. The mass did not pulsate

and the borders were smooth. A lung tumor was suspected and radiotherapy was instituted. The patient died of a tuberculous cachexia three months later. The autopsy examination revealed an enormous aneurysm of the descending aorta, which was completely filled by a large thrombotic blood clot—hence no pulsation. The aneurysm had eroded the anterior surfaces of several contiguous vertebrae.

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CHARLES S. CAPP, M.D.

CONTRAST MEDIA

The Roentgenologic Demonstration of the Lacrimal Ducts by Means of a New Contrast Medium. H. Gasteiger and S. Grauer. *Röntgenpraxis*, May 1, 1931, III, 410.

Roentgenologic examination of the lacrimal ducts, which have been filled by a thorium dioxyd sol, containing 50 per cent thorium, is highly recommended by the authors. The injection is easy, harmless, and the medium casts a good shadow. The position and type of a suspected stenosis may easily be demonstrated and fistulas also may be shown. Traumatic changes and anomalies are easily demonstrable. The roentgenologic diagnosis has been of great assistance, and the authors prefer to use this method.

H. W. HEFKE, M.D.

Paths of Absorption and Excretion of Sodium Tetraiodophenolphthalein. A. J. Delario. *Jour. Lab. and Clin. Med.*, January, 1931, XVI, 329-340.

Experimental work on the paths of absorption and excretion of sodium tetraiodophenolphthalein reveals the following facts:

(1) Dye is absorbed by both the small and the large intestine after oral or rectal administration.

(2) Dye given intravenously leaves the blood stream in from two to four hours. An occasional trace is found later as it is reabsorbed from the intestine or gall bladder.

(3) The liver starts to excrete the dye in one or two hours. It reaches its maximum concentration in the bile in five hours without the gall bladder, and in seven hours with a gall bladder *in situ*.

(4) The liver will excrete the dye a little at a time for six or seven days.

(5) The liver excretes about from 60 to 70 per cent of the dye, probably as sodium tetraiodophenolphthalein, without changing or conjugating it.

(6) Urine excretes about from 5 to 10 per cent of the dye—some in the inorganic state.

(7) The large intestine excretes about 25 per cent of the dye.

(8) Some dye is rendered insoluble as the dye-containing bile strikes pancreatic juice.

(9) Fat causes a greater amount of the dye to be rendered insoluble in the small intestine, more liver secretion of the dye, and probably a greater gall-bladder absorption.

A. O. HAMPTON, M.D.

DOSAGE

Roentgen Dosimetry. Grebe. *Schweiz. med. Wchnschr.*, April 25, 1931, LXI, 406.

The author discusses the methods of measurement, considering chemical changes, biological effects, and changes in the electrical charges of gases.

H. C. OCHSNER, M.D.

Multiplication of the Effect of Very Small Radium Doses on Tissue Cells *in Vitro*. Albert Fischer and M. Horwitz. *Strahlentherapie*, 1931, XL, 465.

Tissue cultures of osteoblasts were irradiated with such small doses of radium that no definite effect could be shown. If the exposed cultures were placed in the icebox, an effect of the irradiation could be detected. Arsenic acid in concentrations of $1:3 \times 10^6$ up to $1:9 \times 10^6$ had the same influence. Heat did not affect the cultures in this manner. It is concluded from these experiments that the effect from very small doses of radiation on biological objects can remain latent and become apparent only after the action of an otherwise harmless agent.

ERNST A. POHLE, M.D., Ph.D.

The Influence of Cones on the Dose. Stephan Epstein. *Strahlentherapie*, 1931, XL, 493-507.

The influence of cones on the dose in X-ray therapy was studied by the author by means of a Küstner ionization instrument. He found that with or without a cone, as well as between different types of cones, there may be a difference in the surface dose in deep therapy up to 20 per cent or higher. Three factors are responsible for these variations: (1) The

secondary irradiation of the filter; (2) the stem radiation, and (3) the absorption in the wooden bottom of the cone. For the practice one must conclude, therefore, that calibrations of X-ray apparatus should be carried out with the same cone attached as used during the treatment. Cones should be standardized so as to avoid appreciable variations.

ERNST A. POHLE, M.D., Ph.D.

EXPERIMENTAL STUDIES

Experimental Studies Concerning the Problem of Secondary Radium Rays. J. Suetsugu. *Strahlentherapie*, 1931, XL, 401-426.

The author studied the effect of secondary radium and roentgen rays on cultures of *B. prodigiosus*, ascaris eggs, and photographic emulsion. Pertinax, aluminum, copper, silver, and lead were used as secondary radiators. The experimental set-up is described in detail. It appeared that for secondary radium rays there was a remarkable agreement between the biologic experiments done on bacterial cultures and on the photographic emulsion. The results obtained on bacteria and on ascaris eggs were also in good agreement in contrast with the same experiments conducted with secondary roentgen rays. The agreement in the case of secondary radium irradiation is explained by the fact that it has a higher penetration and is not, as the secondary electrons produced by roentgen rays, already absorbed in the upper layer of the absorbing material. The differences in the quantitative relations are probably due to the difference in the absorption laws for roentgen and gamma rays of radium. The dependence of the secondary irradiation from the atomic number was much less pronounced with gamma rays than with roentgen rays. Marked discrepancies appeared also between the entering radiation and the outgoing radiation. The secondary radiation on the exit side of the absorbing layer reaches a minimum for metals of medium atomic number.

In the physical experiments this was found if tin served as a secondary radiator. The maximum amount of secondary rays is produced by lead; the materials with lower

atomic number, as, for instance, pertinax, produce only slightly less secondary radiation. Further analyses of the experimental results showed also that at the side where the radiation enters, the intensity of the secondary metal radiation is higher, while on the side where the rays leave the absorbing layer, the secondary beta rays of the organic material are more effective. For practical purposes, certain deductions may be drawn from this work, particularly as to the proper applicators for radium treatment. If, for instance, it is desirable to have a minimum of secondary rays, it would be best to place a material between radium applicator and tissue which has an atomic number in the neighborhood of that of tin. Further experiments are necessary, however, to prove this assumption.

ERNST A. POHLE, M.D., Ph.D.

Measurements of the Distribution of Heat Rays in Various Parts of the Animal Body by Means of the Photographic Method. J. Plotnikow and R. Mibayashi. *Strahlentherapie*, 1931, XL, 546-561.

The authors determined quantitatively, with the photographic method, the longitudinal dispersion effect (Plotnikow) in liver, skin, muscles, and other tissue. In certain organs, the dispersion was so high that the entering light rays were partially returned through the entering surface. This shows that a transparency of the body for light can not only be caused by reflection and absorption but also by a complete inner dispersion. The significance of these findings for certain medical problems is discussed.

ERNST A. POHLE, M.D., Ph.D.

THE FOOT

The Weak Foot. W. H. Daniels. *United States Vet. Bureau Med. Bull.*, March, 1931, VII, 246-249.

In a discussion of the normal anatomy and mechanism of the foot, the author considers that weight-bearing is accomplished by a series of arches formed by the tarsal and metatarsal bones which are strengthened by the

ligaments and tendons of the foot. The medial and lateral anteroposterior arches are the main supports. The medial arch is made up of the os calcis, astragalus, scaphoid, the three cuneiforms, and the first, second, and third metatarsals. The lateral arch is composed of the os calcis, cuboid, and fourth and fifth metatarsals.

The principal causes of pes planus in children are infantile paralysis and genu valgum. In adults this condition is found frequently in those occupations requiring constant weight-bearing. Poorly shaped shoes which hold the front part of the foot in the everted position, thus causing a constant strain on the plantar fascia and ligaments, are the principal cause of pes planus.

In severe cases the external malleolus becomes flattened and rounded and the astragalus is dropped from its normal position above the os calcis to the inside of this bone. Changes are also noted in the os calcis, scaphoid, and cuboid. The scaphoid and cuboid are later displaced, resulting in the loss of the normal play of the foot.

The most important symptoms are pain, distortion, tenderness, and spasm of the foot. The gait of the patient suffering from weak foot is characteristic, as he shuffles along with his feet everted. The author advises having the patient stand on a cardboard blackened with camphor smoke to determine weight-bearing. X-ray examination will show the relationship of the bones to each other.

The treatment depends on the kind and severity of the case and includes adhesive plaster straps, contrast baths, exercise, proper shoes, arch supports, and, in extreme cases, plaster casts.

J. N. ANÉ, M.D.

GALL BLADDER (NORMAL AND PATHOLOGICAL)

An Improved Method for Oral Cholecystography. Carl Sandström. *Acta Radiologica*, 1931, XII, Fasc. 1, No. 65, pp. 8-22.

The Maria Hospital, Stockholm, employs

oral cholecystography exclusively. The author attributes their excellent results to (1) their radiographic technic and (2) an improved method of giving the dye.

Sandström advocates making films in various positions, using compression technic, such as Åkerlund employs in examination of the duodenal bulb, also fluoroscopic observation to ascertain the mobility of the gall bladder and the presence of tenderness on pressure. An enema is given immediately before the first films are made.

The author, upon attempting to determine whether the cause was imperfect absorption of the dye or a pathologic gall bladder, describes difficulties met with in patients with poor gall-bladder shadows. Small non-opaque stones may not be visible in a poorly filled gall bladder.

It is known that the iodine salt used in cholecystography is eliminated from the body slowly and that it is re-absorbed by the intestine after evacuation from the gall bladder. Sandström makes use of this fact by giving his patients repeated doses of the dye on successive days instead of one massive dose.

Three methods of divided administration are described.

(1) At bedtime the patient takes one-half the usual dose of dye (1.5 to 2 grams) in alkaline, carbonated mineral water. During the following day he eats small meals and avoids gas-forming carbohydrates. The last meal of the day, a very small one, must contain no fats or egg yolks, and should be taken about 5 P. M. At 9 P. M. the patient takes a full dose of dye (3-4 grams). The next morning the roentgen examination is begun. This is the method which is preferred in the Maria Hospital.

(2) Late in the evening the patient takes 1.5 to 2 grams of dye. At breakfast the next morning he again takes 1.5 to 2 grams. The evening meal must be very light and is taken about 5 o'clock. At 9 P. M. the patient receives 1.5 to 2 grams of dye. The roentgen examination is made as usual on the following day.

(3) The patient has a small meal at 5 P. M., and at 9 P. M. he takes from 3 to 4 grams of dye. The following morning, films

are made of the gall-bladder region. If the gall bladder is well filled or definite stones are seen, the examination is continued the same day in the ordinary way. However, if no gall-bladder shadow is seen or if a poor one is evident, the patient is allowed his meals during the day, takes his last food at 5 P. M., and at 9 P. M. has another full dose of dye. On the following day, the X-ray studies are completed as usual. This method has the advantage of consuming less time, if the first dose is sufficient, and of serving as a check-up in cases of poor filling or no shadow. On the second morning the author has often seen a normal gall-bladder shadow in persons who presented no visible shadow the first day.

The best shadows, in the divided dose method, are usually obtained 12 hours after the last dye is taken.

The advantages of this method of cholecystography are as follows:

(1) Normal patients show denser gall-bladder shadows with much less variation of concentration than when the ordinary one-dose method is used.

(2) Many patients who give no visible gall-bladder shadow with the usual technic have shown satisfactory filling with divided doses of dye.

(3) Reactions are milder than with single large doses of dye. Only 17 per cent of cases present mild nausea; 73 per cent have no symptoms at all. Only those patients with high grade cholecystitis have vomited.

The author has used this method as a control test in 53 cases that have had previous examinations by the one-dose technic. Thirty-one of these patients showed no shadow with the single dose, and 22 had a very poor filling. Nine of the no-shadow cases, when examined by the new method, had normal gall bladders; 6 had good filling and definite evidence of stones; 2 had persistent poor filling, and 14 again failed to show any visible gall-bladder shadow. Of the cases with poor shadows at the first examination, 9 showed normal gall bladders when re-examined; 7 showed definite gall-bladder shadows with stones; 1 showed a well-filled gall bladder, with constriction of the body, and 5 continued to exhibit poor filling.

The divided dose method has been used in 152 cases: 51 of these patients have come to operation. The roentgen diagnosis has been confirmed in all but two of them. One of these patients, who had no gall-bladder shadow by cholecystography, was found to have a normal gall bladder, but there was a large tumor of the adrenal which displaced the liver. The other patient also showed no filling of the gall bladder at two cholecystographies, but at both examinations he was drunk. At operation he was found to have a normal gall bladder but definite pathologic changes in the liver.

The author regards the divided dose method of oral cholecystography as entirely comparable to the intravenous method in reliability. He stresses that from his experience he believes the dye to be better given in alkaline, carbonated mineral water than in any other medium he has tried.

A. L. HART, M.D.

Gall-bladder Visualization and Jaundice. E. L. Walsh and A. C. Ivy. *Proc. Soc. Exper. Biol. and Med.*, January, 1931, XXVIII, 382.

The authors demonstrated that in obstructive jaundice in dogs the gall bladder was slow to visualize after the administration of tetraiodophenolphthalein, and the usual density of the shadow was decreased. They ligated the common bile ducts of five normal dogs, and from 60 to 96 hours later the dye was injected. The gall-bladder shadows became faintly visible in from 14 to 50 hours. While some slight increase in density was observed later, the "normal density" was not noted at any time.

They also confirmed the findings of Copher, showing that the disappearance of the gall-bladder shadow, following a fatty meal, was accomplished by the exit of most of the gall-bladder contents through the biliary passages. After visualizing the gall bladders of five dogs by means of the dye, the common bile ducts were ligated and fatty meals were fed to the animals daily. The gall-bladder shadow be-

came more dense after two or three days and the density persisted for two weeks, after which time further observations were not made.

J. N. ANÉ, M.D.

Uroselectan: A Radiological and Urological Study. Bransford Lewis, Grayson Carroll, and Martyn Schattyn. *Southern Med. Jour.*, March, 1931, XXIV, 206-210.

Cystoscopic urography is not always practical and the method of examination by uroselectan is supplementary. Each method of examination has its place. The cystoscopic technic gives roentgenograms which are superior to those following the administration of uroselectan. The evidence is positive while that of uroselectan is negative. In the method, the patient drinks freely of fluids the day before the injection, and the intestines must be as free from contents as possible. A "flat" roentgenogram is taken before the injection. The technic advised by the authors of this method is followed, except that the time is reduced to ten minutes. From three to five roentgenograms are taken, according to the requirements of the case. It has been shown that normally, 90 per cent of the uroselectan injected is eliminated by the kidneys, 60 per cent in the first two hours, 25 per cent in the next hour, and the remainder in the next four hours, which facts may be utilized in making roentgenograms. A child of seven years receives one-half, and one of two years, one-fourth the adult dose. There is no object in dividing the dose between the two arms as suggested by some authors. Six cases are cited.

W. W. WATKINS, M.D.

Gaseous Pericholecystitis with Cholecystitis and Cholelithiasis. C. F. Hegner. *Arch. Surg.*, June, 1931, XXII, 993.

The author reports the case of a man, 62 years of age, suffering from an acute gall-bladder attack. Cholecystography was done and resulted in none of the dye being seen in the gall bladder, but that organ was seen to be distended with gas, which increased

very markedly in the next two days. At operation, the gall bladder was found to be much distended with gas. There were many adhesions around this area, and a number of small abscesses in the wall. Because of difficulty from bleeding, a drainage was done, this being followed by death several days later.

At autopsy, the gall bladder was found to be perforated by a calculus and it contained other calculi as well. A specimen of the blood around the tumor mass after the surrounding adhesions were separated showed a pure culture of an atypical Welch's bacillus. Various cocci were also found.

HOWARD P. DOUB, M.D.

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

Radiologic Examination of the Stomach after Gastro-enterostomy. René A. Gutmann. *Bull. et Mém. de la Soc. de Radiol. Méd. de France*, February, 1931, XIX, 58.

Many diverse lesions are present and may be demonstrated by giving a small glassful of a thick barium mixture, followed by manual palpation of the stomach. Localized perigastric or generalized gastric adhesions may be noted and often stenoses of the stoma opening may be demonstrated. Frequently there is a small peptic ulcer in the stoma opening itself. Stereoscopic films may show a niche not seen at fluoroscopy.

CHARLES S. CAPP, M.D.

Fluoroscopy in Gastro-intestinal Diseases. Edwin Boros. *Med. Jour. and Rec.*, Dec. 3, 1930, CXXXII, 551-553.

The majority of clinics abroad subscribe to the dominance of fluoroscopy in gastro-intestinal X-ray examination, and the taking of films is added only in borderline cases, or to preserve records. In this country, while fluoroscopy is done routinely, it does not seem to the author that it has the prominence it deserves. In fluoroscopy, the patient should

be examined in the erect, recumbent, and lateral positions, the latter especially for adhesions about the stomach. The chest should be included in every gastro-intestinal examination. Fluoroscopy, though regarded as of primary importance, should be supplemented by films.

W. W. WATKINS, M.D.

The Reflex Influence of the Colon, Appendix, and Gall Bladder on the Stomach. F. M. Smith and G. H. Miller. *Archiv. Int. Med.*, December, 1930, XLVI, 988-993.

Distention of the colon and introduction of croton oil into the colon or appendix caused marked increase in tone and peristaltic action of the stomach, which frequently became violent and occasionally reversed. Atropine abolished this effect; barbital anesthesia had no influence. Identical results were produced by the same chemical irritation of the gall bladder, while manipulation alone had no effect. In a patient comparable results were obtained by distention of the colon, which elicited also typical epigastric distress.

The paper, which refers to previous publications and statements of other authors who are of different opinion on the subject, illustrates the intimate interrelationship of the different organs of the digestive apparatus, which is of such great clinical importance.

H. A. JARRE, M.D.

Sympathectomy for Megalocolon. D. E. Robertson. *Can. Med. Assn. Jour.*, March, 1931, XXIV, 359.

This is a report of three cases of megalocolon, a condition which is congenital in origin, sometimes known as Hirschsprung's disease. These cases were treated by interference with the lumbar sympathetic trunk, following the work of Wade, Judd, and others.

The condition is characterized by marked constipation and great dilatation of the whole colon, from the cecum to the pelvirectal sphincter. The caliber of the colon is five times the width of the sphincter, while the walls of the colon are four times the thick-

ness of the sphincter. A destructive lesion of the nerve ganglia at the pelvirectal sphincter acts as a direct obstacle to the descending peristaltic waves and is the cause of the subsequent dilatation and hypertrophy which ensues above. Inasmuch as it has been demonstrated that *some* of the large bowel sphincters are controlled by the lumbar portion of the sympathetic nervous system, it is fair to assume that *all* of the large bowel sphincters are so controlled. Hence, if the lumbar segments of the sympathetics were severed, it might be expected that the contraction of the pelvirectal sphincter would be released and the colon be permitted to resume its normal function. As a matter of fact, this is what actually did happen subsequent to operation, and the operation of left lumbar ramisection has been demonstrated to be a cure for megalocolon.

The three cases which are reported are well illustrated by reproductions of X-ray films, showing the colon before and after the operation. The operation is described in detail and the subsequent history closely followed.

In two of the cases there was a relapse, which, however, yielded to a course of frequently repeated enemas.

In a footnote, three cases are reported by the author as having been successfully operated on since the paper was written.

L. J. CARTER, M.D.

Gastric Hemorrhage Due to Familial Telangiectasis. L. Napoleon Boston. *Am. Jour. Med. Sci.*, December, 1930, CLXXX, 798.

The author reports three cases of gastric hemorrhage due to familial telangiectasis. These patients had telangiectasis of the skin and mucosa, as well as recurrent hemorrhages from both the stomach and the rectum. In each instance, the history indicated other members of the same family or near relatives who had experienced similar attacks of bleeding from mucous surfaces.

Characteristics of this condition are as follows: (1) Blood-clotting time is within normal limits; (2) blood platelets number from 250,000 to 400,000; (3) secondary anemia is

present; (4) patients recover rapidly following seemingly large hemorrhages; (5) patients do not bleed extraordinarily after surgical operations; (6) other symptoms suggestive of gastric lesions are absent.

In spite of the fact that the patients had been victims of recurrent gastric hemorrhage since early life, each lived to be over fifty years of age.

The tendency to familial hemorrhage is transmitted by both maternal and paternal parents to the offspring.

ROE J. MAIER, M.D.

Conditions Commonly Called Colitis. J. Arnold Barger. *Am. Jour. Roentgenol. and Rad. Ther.*, March, 1931, XXV, 308-313.

The syndrome of mucus in the stools, with intestinal irritability, is considered by the author ordinarily to indicate some abnormality of the general body state; hence some term such as "irritable colon" is preferred to "mucous colitis" or "spastic colitis," the term "colitis" being reserved for true infectious diseases of the colon, such as chronic ulcerative colitis, amebic colitis, bacillary dysentery, and tuberculous colitis. Too often, "colitis" is diagnosed, and an organic disease thereby suggested when psychotherapy will prove much more effective in controlling the symptoms than vaccines, medicated enemas, or intestinal douches.

Of the 200 cases at the Mayo Clinic, where a previous diagnosis of colitis had been made, all had definite symptoms of neurosis, many giving a history of nervous strain, excessive physical or mental effort, family difficulties, or excessive use of tobacco or alcoholics. Teachers, preachers, lawyers, salesmen, draftsmen, and merchants constituted a large percentage of this group, with 58 per cent being women and 42 per cent men.

Three groups were recognized: (1) those with loose, frequent stools; (2) those with obstinate constipation, and (3) a small group with organic lesions. Common symptoms were: generalized abdominal discomfort, particularly in the left side, occasional sharp cramp-like pains; bloating, and the passage of mucus, varying from flecks to large tubular

casts. These symptoms were often associated with numerous complaints in other parts of the body.

Proctoscopic examination revealed normal mucosa in all cases, with repeated stool examinations being entirely negative in 90 per cent of the cases, and in the remaining 10 per cent such parasites of questionable clinical significance as *Endamoeba coli*, *Chilomastix mesnili*, and *Endolima nana* being usually found.

Roentgenologic studies of these patients revealed diverticulosis in only 4 per cent of the cases. The barium enema examination is considered more valuable for the analysis of this group of patients than the opaque meal, which is only occasionally used.

J. E. HABBE, M.D.

Leukoplakia of the Stomach: Report of a Case. Harry A. Singer. *Archiv. Path.*, March, 1930, IX, 676-682.

The author has found only one other case reported in the literature, but squamous epithelium has often been noted microscopically in the stomach. The patient, a male, 51 years of age, presented an X-ray appearance of an hour-glass constriction and canalization of the middle portion of the stomach. There was marked gastric stasis. The roentgenologist diagnosed probable carcinoma and suggested the possibility of syphilis, the patient revealing both a four plus positive Wassermann and a Kahn. Upon resection of the diseased portion of the stomach, a 2 cm. area of leukoplakia was found, at the anterior wall of the proximal end of the specimen.

A. O. HAMPTON, M.D.

Diagnosis and Treatment of Acute Intestinal Obstruction. José Mendonca. *Surg., Gynec. and Obst.*, June, 1931, LII, 1115-1120.

Acute intestinal obstructions are divided in two classes: dynamic, and mechanical, the former being caused by trauma or paralysis. A great deal of stress is placed on the patient's history, in his own words, in differentiating dynamic from mechanical obstruction, and, in most cases, one examination alone is not sufficient.

The author stresses the necessity of careful physical examination and makes the following statement:

"The latest advances in roentgenography make it possible, in almost all the cases, to obtain data to confirm the diagnosis." However, he does not state to what advances he refers. Morphine is advocated with the patient in collapse from violent pain or from intestinal paralysis caused by renal or hepatic colic.

A tabulation of differential diagnosis of the dynamic and mechanical types of ileus is given. Dynamic ileus is surgical only when the intoxication is so advanced that drainage is absolutely necessary, or when the condition that caused the ileus calls for operation, while in cases of mechanical obstruction, in which enemas have failed to restore the permeability of the intestine, early laparotomy is urged. Supportive treatment is also advocated.

D. S. CHILDS, M.D.

Pathology of the Lower Colon. Rudolf Pohl. *Röntgenpraxis*, April 15, 1931, III, 337-345.

Three unusual cases of interest are described. The first case is a large myoma of the rectum which could be shown plainly by a barium enema. The author has not found similar roentgenograms in the literature. The prognosis appears dubious in such cases, as malignant degeneration very often takes place. One and one-half years after an operation the patient died as the result of a sarcomatous recurrence.

A very large fecalith was found by roentgenologic examination in a two and one-half-year-old boy who was markedly constipated. Physical examination showed a large mass in the lower abdomen, with rigidity. The barium flowed around this large mass in the rectosigmoidal region, and an X-ray film showed incrustation of the tumor with calcium salts.

The diagnosis of diverticulitis leading to a definite stenosis in the sigmoid is discussed in the third case. The roentgenologic appear-

ance of the mucosa surrounding the stenosis is of great importance in the diagnosis between benign and malignant stenosis. Re-examination after medical treatment usually shows definite improvement and excludes malignancy.

H. W. HEFKE, M.D.

Syphilis of the Stomach Simulating Carcinoma. George Bell and A. H. Tebbutt. *Med. Jour. Australia*, Jan. 17, 1931, I, 81. (Reprinted by permission from *British Med. Jour.*, May 9, 1931, No. 3670, p. 86 of *Epitome of Current Medical Literature.*)

The authors report the case of a naval stoker, aged 37, who complained of dull aching pain over the epigastrium, and sickness soon after food. The duration of the illness was six months, and there was no history of venereal disease. He had lost weight, and his bowels were constipated and irregular. There was tenderness over the pyloric area but no palpable mass.

An X-ray examination revealed a subtotal pyloric obstruction and a large filling defect of the pylorus, which suggested malignant disease. A fractional test meal showed a fasting residue consisting of 200 c.c. of bile-stained fluid, with much muco-pus and no acid. Occult blood was present. After a test breakfast there was neither hydrochloric nor lactic acid. The stomach did not empty in three hours. Malignant disease of the pyloric end of the stomach was diagnosed, but the Wassermann test gave a strongly positive reaction.

The patient was given intensive antisyphilitic treatment for three weeks, and was then submitted to laparotomy. The pyloric end of the stomach, which was found to be infiltrated and thickened, was resected and a gastro-enterostomy was performed. Recovery was uneventful. Macroscopic and microscopic examinations showed erosion of the mucosa not involving the muscularis. There was marked infiltration of the submucosa by round cells, plasma cells, endothelial cells, and eosinophils. In the muscularis and the submucosa were found giant-cell systems typical of tubercu-

losis. Marked obliterative endarteritis was found in several vessels.

Studies on the Stereoscopic Demonstration of the Gastro-intestinal Tract on the Basis of the Mucosa Technic. Roeck. *Röntgenpraxis*, May 1, 1931, III, 395.

Stereoscopic films of the gastro-intestinal tract are of enough value, compared with the ordinary technic, to warrant further trials. The patient drinks a small amount of a thin barium mixture under the fluoroscope. By turning the patient to the right, then to the left, and again on his back, a filling of the duodenum is accomplished in most cases. A very fast technic must be used in order to prohibit motion, one-twentieth of a second being used (from 160 to 200 ma.) for the exposure. The time for shifting the apparatus and changing the films is given as one-half second. The anterior and posterior wall of the stomach may be easily differentiated by stereoscopic examination.

H. W. HEFKE, M.D.

GASTRO-INTESTINAL TRACT (THERAPY)

The Treatment of Peptic Ulcer. I. W. Held and A. Allen Goldbloom. *Can. Med. Assn. Jour.*, March, 1931, XXIV, 372.

There is no specific medical treatment of peptic ulcer at present, certainly none based on pathogenesis and etiology.

Therapeutic measures should be adapted to the condition of the ulcer. But the difficulty is that no method, not even the X-ray, can determine in every case exactly the condition of the ulcer. Cases have been met in which the most exact X-ray studies have revealed no evidence of ulcer, and yet hemorrhage or perforation has developed within a week. On the other hand, cases with a distinct deformity of the stomach or duodenum, with even a large niche suggestive of begin-

ning malignancy, improve rapidly under medical treatment, so that, roentgenologically, the niche is seen to become smaller or disappear.

The first consideration in the treatment of a non-bleeding or non-perforating ulcer is the obtaining of rest of body. At present the majority of authors advocate ambulatory treatment, having in view the economic advantage to the patient. The authors regard this as a mistaken point of view. By not insisting that the patient go to bed, we allow the ulcer to develop and encourage serious complications, at times doing more by our care not to injure the economic condition than if we had advised bed treatment for two or three weeks.

Coincident with rest of body, we must try to reduce to a minimum the most important gastric functions, namely, secretion and motility. In order to do this, we must understand what articles of diet will least tax gastric secretion and motility and yet be nutritious enough. Today we have complete information on the effect of the various foods on gastric secretion through the work of Rehfuess and his pupils, while the work of the pupils of Von Bergmann has furnished roentgenological evidence of the influence of food on gastric motility. From these two standpoints the authors discuss the action of such foods as milk, carbohydrates, fat, proteins, vegetables, fruit juices, soups, and condiments.

Alkaline medication is given for the relief of epigastric distress only when specially indicated. The patient is impressed with the fact that the dietetic is the main treatment.

In the treatment of hemorrhage complicating peptic ulcer, rest in bed and the withholding of all food by the mouth during the acute stage are imperative. The usual treatment of hemorrhage should be employed, as morphine, adrenalin, glucose, blood transfusion, and so forth.

In the treatment of callous and stenosing ulcers, one must be very careful to rule out spasm, as this may simulate organic changes very closely. If organic stenosis can be determined, medical treatment should be employed only with a great deal of apprehension, and only when either the age of the individual or

some co-existing constitutional disease makes operative procedure fraught with danger.

The penetrating ulcer is indicated by the existence of a niche which will, in most cases, yield to medical treatment of the most rigid type. The passage of the stomach tube is interdicted. The results of treatment should not be judged by the disappearance of the niche, for it may disappear and the ulcer remain. The patient's subjective improvement is the only criterion of the cure of the ulcer.

The authors refer to the treatment by X-rays, stating that in a personal communication from Dr. I. Seth Hirsch he informs them that he has obtained good results from this type of treatment.

The indications for surgery may be classed as relative and absolute. The relative indications are as follows: The patient's economic condition, the recurrence of symptoms, disturbances of motility from persistent hypersecretion, a niche 3 or 4 centimeters in circumference, marked delay in the emptying time of the stomach, and gastric hemorrhage. The absolute indications for surgery are as follows: Occult bleeding, epigastric pain with evidences of collapse, acute perforation, third degree pyloric stenosis or organic hour-glass contraction, marked adhesions to adjacent organs, and chronic appendicitis or gall-bladder disease.

L. J. CARTER, M.D.

GENITO-URINARY TRACT (DIAGNOSIS)

A Study of Vesicorenal Reflexes and of the Possibility of a Renorenal Reflex.
James I. Farrell. *Jour. Urol.*, May, 1931, XXV, 487-496.

Summarizing this very interesting article, the author finds that both distention of the bladder and stimulation of the pelvic nerve produce a change in the renal volume and inhibition of the urinary flow, which may be partial or complete. When the splanchnic nerve is sectioned, however, distention of the bladder or stimulation of the pelvic nerve has no effect upon the urinary flow. Stimulation

of the hypogastric nerve also fails to alter it. Distention of the renal pelvis on one side causes an inhibition of the urinary flow and a vasoconstriction of the vessels of the opposite kidney. This is manifested by a reduction in renal volume, which can be greatly magnified by the injection of a diuretic, such as glucose, immediately preceding the distention of the renal pelvis.

During the active stage of micturition, no urine flows from the ureters. This appears to be a protective mechanism to prevent back-pressure on the kidney.

In conclusion, the author presents the following facts:

1. That the bladder receives afferent nerves capable of giving rise to sensation is well known, and many of these impulses traverse the pelvic nerve. In addition, the presence of efferent fibers in the splanchnic nerve to the kidney has been demonstrated. Most of these efferent fibers are, in all probability, vasomotor in character. That a reflex relation exists between the bladder and kidneys is demonstrated by the experiments which showed that the urinary flow was inhibited by stimulation of the pelvic nerve, except after section of the splanchnic nerve.

2. When distention of the bladder is present, urinary flow is diminished, this being, in all probability, a protective mechanism to prevent pressure within the renal pelvis. Clinically, in urinary retention, when the bladder is chronically distended, this reflex is apparently destroyed, since in many of these cases hydro-ureter and hydro-nephrosis develop. In this connection, the absence of a flow of urine from the ureters during micturition is interesting. This is, no doubt, due to contraction of the ureters in order to prevent back-flow of urine.

3. Reflex inhibition of urinary secretion has been observed, following operations on the kidney and other organs, and, experimentally, distention of one renal pelvis produces pain, a decrease in the blood pressure, and inhibition of the urinary flow on the opposite side. While it is probable that this inhibition is the result of vasomotor changes within the kidney, nevertheless the experiments clearly demon-

strate that it is possible to influence the urinary secretion of one kidney by distending the pelvis of the opposite kidney. If this interpretation is correct, it would serve to substantiate the existence of a renorenal reflex.

DAVIS H. PARDELL, M.D.

Radiography during Operation for Renal Calculus. R. J. Willan. *Brit. Med. Jour.*, Oct. 4, 1930, II, 552, 553.

The author, in attempting to decide whether the so-called recurrent renal calculus was really a recurrence or whether it was a case of a stone or a fragment of a stone being left behind, after radiating a large series of exposed kidneys which were either known to contain calculi or suspected of doing so, which did not show up in an ordinary radiogram, has come to the following conclusions:

1. Radiotherapy of an exposed kidney is helpful in guarding against the recurrence of a stone, and should be a routine procedure in all nephrolithotomy operations.

2. Detection of the exact site of a renal calculus by radiography is invaluable in preventing the needless sacrifice of renal tissue.

The technic of the procedure is outlined, in which the film in its paper cover, wrapped in sterile gauze, is pushed down into the wound so that it lies under the kidney, after all bleeding points have been sutured, and the exposure is made. The technical difficulties here are less than in screening the exposed kidney, where small calculi are apt to be missed. After a calculus has been located and removed, a further film is made to exclude the possibility of fragments being left behind, which could become the nuclei from which further stones might develop.

Illustrative cases are recorded, demonstrating the several advantages offered by taking X-ray films during the operation of nephrolithotomy.

W. D. MACKENZIE, M.D.

Calcification of Intrarenal Arteries, Giving Roentgen Appearance of Calculi. George Winthrop Fish and Leonard A. Hal-

lock. *Jour. Am. Med. Assn.*, June 6, 1931, XCVI, 1935, 1936.

Calcification of the walls of the large intrarenal branches of the renal arteries, in such a way as to give the roentgenologic appearance of calculi or tuberculous calcification, is extremely rare. No reports of a similar case were found in the literature. Roentgen examination showed numerous shadows which were thought to be small calculi or calcifications, due to tuberculosis in the kidney.

The patient died of carcinoma of the bronchus later, and necropsy revealed large palpable and visible plaques of calcium in the walls of the renal arteries.

Such shadows associated with hematuria might be diagnosed as renal calculi. The results of operation, when performed, have proven unsatisfactory.

C. G. SUTHERLAND, M.D.

Recurrent Renal Calculus: Its Cause and Prevention. Robert H. Herbst. *Am. Jour. Surg.*, April, 1931, XII, 58-62.

After conservative operations for its removal, renal stone recurs in over 15 per cent of the cases. These may be divided into two groups: the true and the false. The latter is by far the most frequent.

Undoubtedly, one of the most important factors in the recurrence of renal calculi is the failure to remove all stones or fragments. Even in cases which have been subjected to a most careful pre-operative roentgenologic study, stones are very apt to be overlooked for the following reasons:

- (1) They may fail to produce shadows on films taken with the kidney in the body.

- (2) Two or more stones may be superimposed on one another, producing one shadow.

- (3) When a stone is removed, especially with instruments, a small piece or pieces may be broken off or left behind, and promptly cause a recurrence.

- (4) They may be seen on the film but not found at operation.

Practically all of these conditions may be avoided by fluoroscopy of the exposed kidney before its replacement, as described by

Braasch; or, better still, by placing a small film behind the delivered kidney and exposing it to the X-ray, as described by Quimby. This small film, in all probability, will show any stone or fragments which have been overlooked and will help in locating those which have eluded the operator. If this method is carried out routinely, the cases of recurrent renal calculi will be greatly reduced. The use of these methods is not a refinement but an absolute necessity in the surgery of renal calculi.

DAVIS H. PARDOLL, M.D.

GENITO-URINARY TRACT (THERAPY)

Röntgen Therapy of Uterine Myoma. Martius. Schweiz. med. Wchnschr., April 25, 1931, LXI, 408.

The following types should be irradiated: (1) Elderly women; (2) hypermenorrhea near the climacteric; (3) young women in whom there exists a contra-indication to operation.

The author uses four fields, 8×6 cm. in size, 2 antero-posterior and 2 postero-anterior, giving a 34 per cent center dose. This necessitates the application of from 350 to 450 r to each field.

H. C. OCHSNER, M.D.

Radium Therapy of Tumors of the Genito-urinary Tract. B. S. Barringer. Am. Jour. Surg., May, 1931, XII, 243-248.

An analysis is made of the effect of radium therapy upon the treatment, prognosis, and general conception of the control of carcinoma of the penis, teratoma of the testis, carcinoma of the prostate, and cancer of the bladder.

From his vast experience with these conditions, the author staunchly advocates the use of radium and deep X-ray in carcinoma of the genito-urinary tract.

1. *Carcinoma of the Penis*.—When the carcinoma is papillary and infiltrating in type, and if Buck's fascia has been penetrated but a slight distance, then operation may be entirely eliminated and the carcinoma controlled by radium, which, as a rule, is applied to the surface. If the infiltration is extensive, excision of the penis 2 cm. beyond the growth should

be done, with immediate dissection of the excised portion, in order to accurately determine the border of the growth. No routine inguinal dissection is performed. Deep X-ray therapy and radium pack, with implantation of radium in any suspicious glands, is the procedure employed.

Primary lesions confined to the foreskin are removed by circumcision, and any suspicious areas remaining are irradiated. If the primary lesion is 2 cm. or less in diameter, superficial, and if metastases cannot be detected, external irradiation alone is used. The tumor is treated with a radium pack, the dose being 1,200 mc.-hrs. per sq. cm., at 1 cm. distance. Of 13 patients in this group, 92 per cent are living without signs of disease. The period of observation varies from eighteen months to nine years, four months.

When deep penetration by the tumor has occurred, preliminary irradiation is followed by conservative amputation. Four patients were treated in this manner, all of whom are alive and well from two to seven years following the operation. If the primary tumor is larger than 2 cm. in diameter and metastases are not found, the treatment of choice is usually irradiation, followed by conservative amputation in from three to four weeks. In extensive tumors with considerable destruction, amputation is performed without pre-operative irradiation. Of 66 patients, 57.5 per cent are alive and, so far as can be determined, free from disease. There has been no operative mortality.

2. *Teratoma of the Testis*.—Brilliant results accompany this form of tumor when radiation is employed. In the primary cases, in which no surgery has been done, the testis is thoroughly irradiated with the radium pack. Deep X-ray therapy and the radium pack are also applied to the course of the spermatic vessels on the side affected. Two months later the testis is removed under local anesthesia, the cord having first been cut. No mortality accompanies this procedure. Of 113 cases, 41 are living and clinically free of disease. The period of observation ranges from twelve months to ten years.

3. *Carcinoma of the Prostate*.—Early di-

agnosis is of prime importance in this disease. Because a certain percentage of prostatic carcinoma is highly malignant and radio-sensitive, a thorough cycle of deep X-ray radiation, using five portals of entry, should be utilized prior to any other procedure. This, at best, gives only about one and a half erythema doses to the prostate. The author believes that somewhere between ten and fifteen are necessary to control the large majority of prostatic carcinomas. Cystotomy should be employed, any obstructive portions of the prostate removed with cutting forceps or a cautery, and the entire tumor, periprostate, periprostatic region, and seminal vesicles, if they are involved, implanted with radium seeds of 2 mc. each to every centimeter of tumor. The mortality of this operation is not so great as that of Young's radical removal, and the effectiveness of this method in controlling prostatic carcinoma will in time be demonstrable.

4. *Cancer of the Bladder*.—In this condition surgery and radium still continue to be contestants for honors. The reason for so many failures in cases in which radiation had been employed has been insufficient dosage. Ten times an erythema dose is necessary to control the radioresistant tumors. This accounts for the failure of deep X-ray, for the maximum obtainable by this method is not much more than one and a half erythema doses.

In doing suprapubic implantation, spinal anesthesia should be used, and the bladder should not be mobilized. The abdominal wound should be thoroughly screened with gauze before opening the bladder, great care being taken not to spill its contents over the wound. After obtaining a good exposure of the tumor, its papillary portions should be removed by some form of cautery. The radium implantation should be very accurate, and, if the bladder is dirty or the radium dose very large, a small suprapubic drainage tube (18 to 20° F.) should be left in place for about a week or longer. The bladder is not sutured to the abdominal wall. One gold seed of 2 mc.-hrs. to 1½ sq. cm. of tumor is a minimum dose. As many as forty such seeds have been used in tumors of large size.

The operative mortality of this procedure in 109 cases was 3.6 per cent compared to that of between 10 and 20 per cent in operative removal.

DAVIS H. PARDOLL, M.D.

GYNECOLOGY AND OBSTETRICS

The Therapeutic Interruption of Pregnancy by Roentgen Rays. M. Ganzoni and H. Widmer. *Strahlentherapie*, 1930, XXXVIII, 754.

This is a reply to Fürst's criticism of the use of roentgen rays to induce abortion. The authors still believe that in cases in which, at the same time, temporary or permanent sterilization is desirable, the roentgen abortion should be given the preference. Their clinical observations have been reported in two articles (*Strahlentherapie*, 1925, XIX, 485, and 1930, XXXVI, 510), dealing with 34 and 39 patients, respectively.

ERNST A. POHLE, M.D., Ph.D.

The Diagnosis of Disproportion. Herbert Thoms. *Surg., Gynec. and Obst.*, May, 1931, LII, 963-970.

The author discusses disproportion and states that this subject divides itself into two factors: the size of the fetus and pelvis. External and internal pelvimetry are discussed, and under the heading, "Summary of Pelvimetry," he concludes that the method is not only inadequate but often misleading. He believes that by the roentgenologic method accurate measurement of both the anteroposterior and transverse diameters of the superior strait can be made; and secondly, by lateral pelvigrams, the relationship of the sacral promontory and anterior surface of the sacrum to the posterior surface of the symphysis pubis may be obtained.

Roentgen pelvimetry, as described by the author, is discussed and his technic outlined, as in some of his previous communications. He says that pelvimetry of the superior strait is the more frequently used, and the lateral technic is employed only when a rachitic pelvis is suspected.

A tabulation is included, so that the biparietal diameter can be constructed from a given occipitofrontal diameter.

To quote from the summary: "It is the writer's opinion that the time has arrived when to treat doubtful cases of disproportion without proper roentgenologic examination is as culpable as to treat fractures without the aid of the same diagnostic means."

D. S. CHILDS, M.D.

X-ray Therapy in Hemorrhages of the Menopause and Uterine Fibromas. Remy-Roux. Bull. et Mém. Soc. Radiol. Méd. France, April, 1931, XIX, 192-195.

One thousand r-units each to four portals of entry, centering on the pelvis, are usually sufficient to stop the uterine hemorrhages of the menopause, with considerable lessening of the vertigo and insomnia. Uterine fibromas at times require 6,000 r-units, while the average case requires 2,000 r-units in from four to six divided dosage treatments.

The voltage factors are as follows: 200 K.V., 1 mm. copper and 2 mm. aluminum filter.

CHARLES S. CAPP, M.D.

The Pathologic Cervix and its Treatment. B. H. Orndoff. Illinois Med. Jour., November, 1930, LVIII, 380-383.

The writer emphasizes the importance of the recognition and treatment of pathologic conditions of the cervix prior to chronic degenerative and malignant changes.

The pathologic changes discussed are as follows: cervicitis, ulceration, ectropion, and erosion. Diagnosis is to be made by palpation, inspection, and trachelograms after the use of radiopaque oils.

The writer then destroys all pathologic tissue by means of electrocoagulation.

The conclusions are as follows: (1) The importance of a pathologic cervix has been emphasized; (2) the general health is often greatly improved when the pathologic cervix is relieved by electrocoagulation; (3) the pathologic cervix may be a focus of infection;

(4) conception has occurred after coagulation when sterility previously existed; (5) recurring perineal and vulvar irritation is relieved; (6) the liability of a malignant change in the cervix after coagulation seems very small; (7) the liability of malignancy in pathologic cervixes not operated upon seems very great; (8) the value of a thorough pelvic examination for women between 35 and 60 years of age cannot be overestimated.

C. H. DEWITT, M.D.

HEART AND VASCULAR SYSTEM (DIAGNOSIS)

Congenital Idiopathic Enlargement of the Heart. George W. Holmes. Am. Jour. Roentgenol. and Rad. Ther., March, 1931, XXV, 320-323.

Congenital idiopathic enlargement of the heart is undoubtedly an uncommon condition, although, as the author points out, only those cases have been reported which have had autopsy proof, and it is quite possible that all do not die in early infancy. The author reports two cases, the first occurring in a female infant of seven months, in whom, clinically speaking, tumor with mediastinal compression and pulmonary infection or congenitally enlarged heart were considered as possible diagnoses. Roentgenologically, the cardiac enlargement was not suspected, because the retrocardiac space was clear and the enlargement into the left chest was obscured by associated atelectasis and pulmonary infection in the left lung. The heart at autopsy showed enlargement of all of the chambers, the weight being 175 grams (normal 34 grams). Microscopically the muscle cells were twice as large as normal. The second case was that of a baby fourteen days old who had had previous diagnosis of and treatment for enlarged thymus. When examined, he showed, on both the physical and X-ray examination, evidence of distinct enlargement of the heart to the left. In this case, the heart at autopsy weighed 50 grams, all cavities being equally dilated, there being a patent ductus arteriosus which allowed the passage of a large probe.

The author calls attention to the difficult position in which the roentgenologist may find himself in such cases as these. With findings similar to those in the second case, he might be disturbed to learn of the sudden death of the infant after a diagnosis of no thymic enlargement had been made from X-ray examination. Again, with findings similar to the first case, a large thymic tumor might be roentgenologically suspected, but the patient would certainly show no improvement under roentgen therapy, and might even die in the course of it, in which latter case death might be attributed to the treatment.

J. E. HABBE, M.D.

Functionally Two-chambered Heart. L. Minor Blackford and Lewis D. Hoppe. *Am. Jour. Dis. Child.*, May, 1931, XLI, 1111.

The case of an infant, aged 6½ months, is reported, with clinical, roentgenographic, laboratory, and postmortem observations. The right atrium opened through the foramen primum into the left atrium, which in turn opened through the mitral valve into a single ventricle. The tricuspid valve was absent. The aortic, the pulmonic, and the bicuspid valves were normal. Extreme stenosis of the ventriculo-bulbar junction prevented the passage of an adequate amount of blood to the lungs. More detailed dissection revealed a small right ventricle in the mass of ventricular muscle. Functionally, it can be stated, the heart was two-chambered. Roentgenograms of the chest showed merely moderate increase in the size of the heart.

F. B. MANDEVILLE, M.D.

The Roentgen Diagnosis of Pericardial Diverticulum. Gösta Jansson. *Acta Radiologica*, 1931, XII, Fasc. 1, No. 65, pp. 50-58.

The author describes in detail a case of diverticulum of the pericardium in a fifteen-year-old girl whom he has observed since January, 1928. During all these three years she

has remained clinically well. A previous diagnosis of mediastinal tumor had been made elsewhere. Examination of the blood showed no evidences of leukemia or of any of the lymphatic tissue tumors.

At the first examination, there was in the inner portion of the right lung field a rounded shadow which was as large as a man's fist. It was sharply demarcated from the adjacent lung tissue, was of the same density as the heart shadow, and arose from the anterior mediastinum. At this time along the left border of the heart in the region of the pulmonary cone and auricular curve, an unusual prominence was also noted. At fluoroscopy, with the patient in the horizontal position, the shadow in the right chest became longer and flatter during inspiration and broader and shorter during expiration. The first diagnosis made was encapsulated exudate arising in the anterior mediastinum.

Subsequent examinations during 1928 showed no change in the chest. But early in 1930 when the patient was seen again, it was found that the mass in the right lung field had changed very little, while there was now in the region of the left hilum a shadow which presented a sharp lateral border. This shadow arose from the mediastinum, and showed pulsation. During respiration, it disclosed the same type of change of shape as the mass in the right chest. At this time it was also possible to detect a weak pulsation in the shadow in the right side.

The author discusses, at some length, Kienböck and Weiss's article on the diagnosis of pericardial diverticulum and points out similarities between his case and the cases reported by other students. There are different opinions concerning the origin of this condition. Probably there is always a fore-running adhesive pericarditis.

In 1914, only eleven cases of this condition had been reported. Kienböck and Weiss were the first to make a clinical diagnosis of pericardial diverticulum during the life of a patient, upon the basis of earlier postmortem discovery of similar conditions. This man was seen at intervals during a period of almost twenty years. In 1908, the diagnosis was sac-

cular aneurysm of the ascending aorta; in 1914, the same; in 1919, intrathoracic tumor; in 1924, saccular aneurysm of the aorta, arising in the right sinus of Valsalva; in 1927, a cystic, encapsulated, pericardial exudate, arising from a previous pericarditis.

The differential diagnosis between mediastinal tumor, diverticulum of the pericardium, and other mediastinal lesions is extraordinarily difficult. Jansson believes that the marked changes he describes in the size and shape of a diverticulum of the pericardium during respiration are due to the fact that this mass is soft and plastic and can therefore be compressed and expanded in a way impossible for a solid tumor. These changes during respiration are more easily detected if the patient is fluoroscoped in the horizontal position. The author does not believe that aneurysm would show such changes in shape during respiration. He is of the opinion that other encapsulated, fluid-containing formations in the anterior mediastinum may show similar signs on roentgen examination.

A. L. HART, M.D.

Velocity of Blood Flow in Health and Disease: Velocity of Blood Flow in Man and its Relation to Other Measurements of Circulation. H. L. Blumgart. *Medécine*, February, 1931, X, 1-75. (Reprinted by permission from *British Jour. Med.*, May 9, 1931, No. 3,670, p. 90 of *Epitome of Current Medical Literature.*)

The author discusses the work of many investigators of the speed of the blood flow in health and disease, and describes the method he has personally employed to determine this velocity. The principle of the method is the injection of radium C, the active deposit of radium, into the antecubital vein, the time of arrival in the other arm being determined by a suitable detecting device. The detection of beta and gamma radiations depends on the fact that these radiations cause ionization of any gas they traverse, and the onset of ionization in a gas is an indication of the presence of the radiation of a member of the radio-active series. By means of a cloud chamber and a

modification of the Geiger counting chamber it is possible to estimate the circulating time from the antecubital vein of one arm to the antecubital artery of the other arm, and also to make an automatic registration of the time of arrival of the active deposit in the right heart—"the arm-to-heart time." The interval between the arrival of active deposit in the right heart and the arteries about the elbow is called the "crude pulmonary circulation time." The advantages and disadvantages of the histamine method are also discussed.

Congenital Idiopathic Hypertrophy of the Heart: A Case with Unusual Family History. Howard B. Sprague, Edward F. Bland, and Paul D. White. *Am. Jour. Dis. Child.*, April, 1931, XLI, 877-886.

The authors report, with necropsy findings, a case of congenital idiopathic hypertrophy of the heart in a girl aged seven months. The weight of the heart was more than five times the normal for that age. The family history, in brief, showed probable identical congenital heart disease in a sister, probable patent ductus arteriosus in a half-sister, rheumatic heart disease in a maternal aunt, and undetermined heart disease in a great aunt. A sister of the latter had ten female children who died at early ages, in several instances from probable congenital cardiac conditions. Observations suggest the probability of an inheritance of a tendency to congenital cardiac anomaly. Roentgenograms showed marked enlargement of the cardiac shadow.

F. B. MANDEVILLE, M.D.

Electrocardiography as a Diagnostic Aid. L. J. Godbey. *United States Vet. Bureau Med. Bull.*, March, 1931, VII, 215-217.

The author discusses the value and the limitations of electrocardiography as a diagnostic agent in determining cardiac disorders. The electrocardiogram is a representation of the nerve path from auricle to ventricle in relation to direction, time, and magnitude of the muscular fibers of the heart in its cycle of contraction. While it is believed to be of value in

heart preponderance, cardiac transposition, and arrhythmia, the electrocardiographic picture is of little or no importance in murmurs or valve lesions.

The author concludes that an electrocardiogram is valuable in cardiac conditions after all other means have been employed as diagnostic aids. He believes that the history of the patient's illness is of primary importance. Inspection and palpation of the patient as a whole and of the cardiac region in particular should be made. Percussion, in the author's opinion, is of little value in this age of radiography. One must also determine by the stethoscope the character, location, transmission, and time of the murmur. With this information known, an electrocardiogram may then give another angle from which one may reach a correct conclusion.

J. N. ANÉ, M.D.

Narrowing of the Aorta at its Isthmus.
Gordon E. Hein. United States Vet. Bureau Med. Bull., March, 1931, VII, 209-211.

The author describes five cases of narrowing of the aorta at its isthmus. He believes that the diagnosis of coarctation of the aorta, proximal to the ductus arteriosus, is practically impossible, except after death, as there are present no characteristic findings. Coarctation of the aorta of the adult type, in which the obstruction is distal to the ductus arteriosus, is more easily recognized if the obstruction be extreme or complete.

The most important findings in this condition, in the opinion of the author, are as follows: (1) Signs of dilatation of the ascending aorta; (2) well-marked collateral circulation involving the branches of the subclavia and the intercostal arteries, which is evident on roentgenograms by erosion of the under surfaces of the ribs; (3) weak or absent pulsations in the abdominal aorta, femorals, popliteals, and dorsalis pedis pulses, in contradistinction to marked pulsations in the carotids, and a well-marked pulse in the radials; (4) difference in the blood pressure in the arms and legs; (5) other phenomena of less importance, such as enlargement of the

heart without obvious cause; unexplained arterial hypertension; the presence of cerebral hemorrhage in the young; weakness in the legs in a person otherwise well developed.

There was an additional group with partial obstruction in which the diagnosis could only be inferred. With the exception of demonstrating dilatation of the ascending aorta and a moderate enlargement of the heart, the roentgen ray was of no aid in these cases. Electrocardiograms were of no help, as in only two cases with extreme narrowing, left preponderance and inversion of the T-wave were present in the first lead, suggesting early right branch bundle block. This group is believed to be the most important one, as these patients have a fairly good outlook as to life.

J. N. ANÉ, M.D.

Galvanometer Tracings Obtained in a Physico-chemical Schema Simulating an Electrocardiogram, and the Influence of Membranes on These Records. Jane Sands Robb. Proc. Soc. Exper. Biol. and Med., February, 1931, XXVIII, 482.

By making and breaking of the primary current rapidly when the primary electrodes were inclosed in a gelatine-coated membrane and recording these interruptions by a string galvanometer in the secondary circuit, the author produced deflections similar to the QRS of an electrocardiogram. When the primary electrodes were inclosed in a collodion membrane, making and breaking of the primary circuit resulted in single monophasic deflections. The relation of membrane polarization to distortions of electrocardiograms is mentioned.

J. N. ANÉ, M.D.

Electrocardiographic Study of Movements of the Heart with Change of Posture. M. H. Nathanson. Proc. Soc. Exper. Biol. and Med., April, 1931, XXVIII, 766-770.

The author demonstrated that a variation occurred in the electrocardiogram when the position of the patient was changed. Electrocardiograms were made of 60 individuals

in the reclining, left lateral, and right lateral positions.

The subjects examined numbered normal individuals and cardiac patients in whom a fixed heart was improbable. The habitus of the individual and the size and displacement of the heart were given due consideration. In 55 cases, or 91 per cent, some definite electrocardiographic alterations were noted on change of position of the body. These variations were seen especially in the QRS wave, although the other waves were modified in the same direction to a lesser degree. These modifications in amplitude and direction of the QRS wave were expressed as variations in the degree of ventricular preponderance.

When the subject was turned from the reclining to the left lateral position, right preponderance was observed in 83 per cent of the cases, left preponderance in 6 per cent, and no alteration in the electrocardiogram was noted in 11 per cent. In shifting from the back to the right lateral position, 35 per cent showed right preponderance, 35 per cent left preponderance, and in 30 per cent no change from the previous record was observed.

In the change from the reclining to the left lateral position, there occurred a predominance of the electrical effects of the rotation of the heart about the longitudinal axis in the majority of cases, with an occasional predominance of the rotation of the heart about the antero-posterior axis. When these effects neutralized one another, no alteration occurred on the electrocardiogram.

J. N. ANÉ, M.D.

HODGKIN'S DISEASE

Some Bone Changes Produced by Diseases of the Hematopoietic System. J. W. Pierson. *Southern Med. Jour.*, March, 1931, XXIV, 191-195.

Of the different types of anemias, the congenital forms produce the most interesting bone changes, which are the result of chronic over-stimulation of the bone marrow. The great increase in the number of young red blood cells in the bone is accompanied by a hyperplasia, which causes the bone marrow

to swell, producing increased pressure on the cortex. The cortex becomes thin and allows the bone to expand, registering on the roentgenogram by an increase in the size of the shaft of the long bones and the depth of the flat bones. The bones appear to be more porous than normal and present a very mottled appearance. Late in the disease, when the bone marrow is replaced by new bone, striations are seen in the marrow cavity of the long bones. In leukemia, in which the bone marrow fat is largely replaced by new blood cells, the roentgenograms show areas of lessened density, giving a mottled appearance to the marrow cavity. The cortex is thinner than normal and the periosteum is elevated, giving a picture somewhat similar to that found in the anemias.

In Hodgkin's disease, striking changes in bones are sometimes found. The bones begin to change their appearance when the fibrotic stage is reached, at which time they are quite porous and give a mottled appearance. Later, areas of necrosis are represented by numerous discrete areas of lessened density scattered throughout the osseous system. At times a large area of bone destruction is found, resembling neoplasm. In Gaucher's disease, the course is chronic and various stages of bone change may be found. The replacement of the normal by abnormal cells is indicated by areas of increased density, with an increase in the diameter of the long bones, of the depth in the flat bones, and of the vertebral bodies. The periosteum is thickened and the picture may be confused with osteomyelitis (chronic).

In many of these cases, all the factors must be considered in order to make a correct differential diagnosis.

W. W. WATKINS, M.D.

Primary Isolated Lymphogranulomatosis of the Stomach. Harry A. Singer. *Arch. Surg.*, June, 1931, XXII, 1001.

Six cases of primary isolated Hodgkin's disease of the stomach are recorded in the literature, and in none of them was the diagnosis made before operation. Five of these patients recovered and remained well.

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spaces into the urinary tubules; (3) development of a perivascular lymphangitis, in connection with inflammatory changes in the calyx-papilla angle, with an associated phlebotic venous thrombosis and congestion hemorrhage.

Two cases are reported, in both of which pyelitis was present, and especially localized in the calyx-papilla angle.

L. J. CARTER, M.D.

Perinephritic Abscess. Harry C. Rolnick and H. J. Burstein. *Jour. Urol.*, May, 1931, XXV, 507-512.

Fifty-five cases of perinephritic abscess are reported. Fever, leukocytosis, and costovertebral or abdominal tenderness are the triad of symptoms which aid materially in the diagnosis of this condition. Previous renal disease was present in 21 patients, direct injury to the back and abdomen in two, retrocecal appendicitis with perforation was responsible for one, and metastatic origin was a factor in the remaining 31. Pyonephrosis, calculous kidney, and retrocecal appendicitis should not be confused with this condition. The mortality rate was approximately 11 per cent. Complete absence of urinary findings, in many instances, may confuse the diagnosis, particularly in the metastatic cases.

The radiographic evidence of the obliteration of the lateral border of the psoas muscle, which is considered diagnostic of perinephritic abscess, could not be demonstrated in four of the cases. In a number of the X-ray films, however, delayed excursion, elevation, and rigidity of the diaphragm were noted on the affected side.

The authors advocate puncture and aspiration as their most valuable aid in the diagnosis of this condition.

DAVIS H. PARDELL, M.D.

The Significance of the Radiological Renal Outline. S. Gilbert Scott. *Proc. Royal Soc. Med.*, March, 1931, XXIV, 577-583.

The author presents a very interesting paper on his subject. The improvement in radiologic technic and equipment has rendered

exposure of the kidney shadow possible in practically every instance. Skill in interpretation, however, has not kept pace with progress in technic. Experience and co-operation with the clinician play major parts.

The intra- or extra-renal character of shadows must be ascertained. Two essential factors are: (1) Satisfactory clearance of the gastro-intestinal tract; (2) efficient abdominal compression. (Dr. Scott recommends the sugar-loaf cushion.) This compression does not restrict renal excursion but clears the field, thereby increasing the shadow values. Individual renal radiographs furnish particularly fine detail.

Information regarding solitary or ectopic kidneys may be elicited. Also, the comparative efficiency of the mate to a badly impaired kidney may be ascertained.

Recognition of three types of renal outline is suggested, namely, globular, elongated, and lobar. The terms are self-explanatory. Along with the lobular (the reversion to the early developmental type), one should suspect other congenital abnormalities.

The position of the kidneys is somewhat variable, and respiratory excursion also shows individual variability. Use is made of this factor for the localization of opacities. Absence of excursion implies fixation by adhesions due to perinephritis.

Abnormalities of size are not so easily interpreted. The development of the kidney is normally in advance of the rest of the body; therefore, in children the renal shadows appear large in proportionate size.

Hypertrophy: Uniform enlargement is usually compensatory.

Syphilis causes an increased density of the organ.

Hydronephrosis: In the early stages no changes are manifest; later, however, general enlargement and lobulation make their appearance.

Pyonephrosis is diagnosed by the detection of pus in an enlarged kidney. The shadow cast by pus is quite distinct from that of calculi.

A local bulging may indicate hydronephrosis, cyst, or newgrowth. Accessory methods of

The author reports a seventh case in which roentgen examination of the stomach demonstrated a constant annular deformity of the antrum and pars media, with about 50 per cent retention in six hours, resulting in a diagnosis of carcinoma. He believes that the clinical diagnosis of isolated lymphogranulomatosis of the stomach is hardly possible in the present state of knowledge. The final diagnosis is a histologic one.

HOWARD P. DOUB, M.D.

The Etiology of Hodgkin's Disease. Editorial. Jour. Am. Med. Assn., March 28, 1931, XCVI, 1089.

A particularly important report has recently been published under the title of "The Etiology of Lymphadenoma," a summary of six years' researches, by C. C. Twort, pathologist to the Manchester Committee of Cancer. By "lymphadenoma" is meant what most American physicians usually call "Hodgkin's disease" and what Germans often designate as "lymphogranulomatosis."

The importance of the report lies in the fact that it is based on an extremely careful study by many methods on a large amount of material. After six years of special study, Twort is compelled to state that, "There appears to be no single feature which permits one to diagnose lymphadenoma with certainty." He ventures the observation, "Besides the presence of lymphadenoma giant cells and the eosinophil cells, mitosis of the various cells outside the germinal centers, in a gland free from hemorrhages, appears to be an important diagnostic point."

It was not found possible to demonstrate consistently any specific animal or vegetable parasite in the diseased tissues. An assortment of other *in vivo* and *in vitro* experiments gave absolutely barren results. Twort says that the different experimental procedures so invariably led to nothing that one might have been dealing with a true newgrowth "instead of what is generally accepted as a granuloma."

CHARLES G. SUTHERLAND, M.D.

KIDNEY

Resection of the Kidney. David M. Davis. Am. Jour. Surg., May, 1931, XII, 272-276.

Three cases are reported in which the author performed a partial resection of the kidney. He concludes that this procedure is by no means extremely difficult or particularly associated with danger. In properly selected cases he finds this method very advantageous, and it is his belief that it should be employed more frequently.

The article is accompanied by several illustrative films.

DAVIS H. PARDOLL, M.D.

Essential Hematuria in Relation to Pyelitis of the Calyx-papilla Angle. James Miller and D. H. Young. Can. Med. Assn. Jour., March, 1931, XXIV, 354.

The term "essential hematuria" signifies bleeding from the kidney, in which, after extirpation, little that is pathologic is found. It is usually unilateral.

The causative factor has been variously regarded. Some urologists think that it is an early symptom of some other disease not yet far enough advanced to be detected. But Bumpus, in a study of 150 cases at the Mayo Clinic, under observation for from 5 to 20 years, found renal disease or malignancy to develop in only 6 cases. Nephritis has been regarded as a basal cause by some authorities. Many observe that the so-called angioma of the papilla is found in association with hematuria. Some believe that infection, either in the papilla or some other portion of the kidney, is the causative factor.

More recently Ceelen has written stressing the importance of the calyx-papilla angle or fornix of the calyx in connection with essential hematuria. He states that three explanations, microscopically, for the hemorrhage are as follows: (1) Direct bleeding from the calyx veins into the pelvis through the establishment of a pyelo-venous connection; (2) perivascular ascent of the calyx hemorrhage into the kidney, with hemorrhagic infiltration of perivascular and intertubular tissue and subsequent rupture of the blood-filled lymph

imply. He agreed with the President that co-operation between the urologist and radiologist was of great importance.

DAVIS H. PARDOLL, M.D.

MASTOID

How shall we Evaluate the Various Manifestations of Acute Mastoiditis? Ben L. Bryant. *Laryngoscope*, November, 1930, XL, 809.

After discussing several laboratory tests, including bacteriology of material from draining ears, lumbar puncture, blood sugar, total and differential white cell count, etc., the author states: "There are many laboratory examinations which are not only useful but essential in the proper evaluation of a case of acute mastoiditis. To some of these, the years have added increasing value; some have decreased in importance. It would seem that the roentgenographic examination has, in a good many instances, held an unjustifiably high position, because, in the final analysis, its chief value seems to be in determining the state of pneumatization, and only by repeated serial plates can one hope to gain much information as to the actual degree of destruction which the interior of the mastoid has undergone."

This impression is amplified earlier in the article. He says it is an established fact that there are widely varying anatomical conditions existing in the mastoid process. There are variations, ranging from the sclerotic through the diploic and irregularly pneumatized to the extensively, ideally, regularly pneumatized mastoid process. The two mastoid processes of one individual frequently vary, although if they are of the pneumatic type they are practically always nearly identical.

A further difficulty to X-ray interpretation is brought out by the results of investigation by Knick and Witte, who found that about one-third (8) of a series of 25 patients who had suffered with otitis media in childhood had a definite restriction of pneumatization of the mastoid cells.

H. REDISILL, Jr., M.D.

MEASUREMENT OF RADIATION

Short Wave Length Radiation: Present Standards for Measuring Quantity and Quality. Francis Carter Wood. *Jour. Am. Med. Assn.*, May 23, 1931, XCVI, 1753-1757.

The exact measurement of roentgen rays is primarily of importance in therapy in order to prevent damage to the patient's skin and to estimate the maximum effect on the tissues to be treated. The quantities of radiation used in radiography are usually so small a fraction of a skin erythema dose that there is little risk of producing any damage to the skin, unless exposures are repeated at too great frequency. It is always wise to ask whether a patient has recently had an X-ray exposure. Legal responsibility will be obviated by careful inquiry. In fluoroscopy, a rough approximation of the erythema dose should be known, and the patient, as well as the operator, should be exposed for the minimum time that will permit the necessary observations. Every record sheet, either for treatment or for radiography, should record former radium treatment or X-ray exposure, exposure to light, an application of any substance to the skin, or the taking of any medicine.

In a general way the effects of radium are estimated largely by direct methods in contrast to roentgen rays, in which the measurements are often indirect. Because of technical difficulties, it has not yet been possible to accurately measure radium in terms of roentgens.

C. G. SUTHERLAND, M.D.

The Dependence of the Wave Length of Small Ionization Chambers ("Thimble Chambers"). Heinz T. Meyer. *Strahlentherapie*, 1931, XL, 576-589.

The dependence of the wave length of thimble ionization chambers was studied after the addition of Si, Al_2O_3 , MgO, and BeO, to the wall material. The amount of the various substances necessary to be added to the basic chamber material (graphite) in order to obtain wave length independence within a half value layer in copper of from 0.15 to 20 mm., was determined. The results of these investigations led the author to the conclusion that not

examination are necessary to differentiate these conditions.

One seldom meets with atrophy of the kidney. The cause is either congenital or acquired, being usually a result of tuberculosis.

The most practical use to which the demonstration of the renal silhouette may be put is in cases in which nondescript ill-formed opacities are present; yet one must determine whether the opacity is within, in front of, or behind the kidney. Shadows cast by calcareous glands, gallstones, opacities in the intestines, pills, and even a pancreatic calculus or a wart on the back, etc., may mimic renal calculi.

The author depends upon the relative position of shadows in the renal area during inspiratory and expiratory excursion for his diagnosis. Two films are taken for comparison: one at full inspiration, the other at full expiration. If the opacity is extra-renal in character, its position fails to remain constant in its relation to the kidney in the excursion of the latter during inspiration and expiration. The method has proved particularly valuable in early cases of renal tuberculosis. It is also very valuable in differentiating renal stones and gallstones. He finds lateral radiography of little practical value. Increasing the density of the renal cortex is of advantage, but cannot be employed routinely in all cases. Oral administration of some preparation for this purpose will be of benefit.

In conclusion, the author states that guesswork diagnosis in radiology with reference to opacities in the renal area must be eliminated. In the discussion which followed, the following participated:

John Everidge stated that Dr. Scott's method would hardly apply in cases of perinephritis in the demonstration of calculi. Here, pyelography—direct or indirect—was advisable. Frank Jeans advocated closer co-operation between the radiologist and the surgeon. E. J. H. Roth claimed that Dr. Scott's contention did not always apply. Calcified lymph glands, adherent to the kidney, perinephric abscess, and floating calculi might confuse the diagnosis if based on the author's assumption. He advised lateral radiography. In the preparation of the patient, vegetable laxatives or two

evenings' limitation of carbohydrates, preceding the X-ray examination, were very satisfactory. Size, shape, and position of the kidney could not be accurately judged under present conditions. Better renal visualization was obtained in stout patients because of the abundance of perinephric fat which acted as a contrast medium. The radiologist's position was only contributory in rendering a diagnosis. E. W. Riches believed that the use of charcoal aided in the preparation of the patient. He cited an example pertaining to the effect of guesswork on the part of the roentgenologist. Cyril A. R. Nitch advocated the use of an opaque catheter in the localization of renal calculi. Also, stereoscopic radiography was of material assistance in dealing with shadows in the renal area. Pyelography occasionally obscured small opacities. Clifford Morson called attention to the clinical picture. H. P. Winsbury White claimed that not all cases of hydronephrosis showed enlargement or lobulation; occasionally there may even be a diminution in size. Pyelography was necessary to make the diagnosis in these cases. Jocelyn Swan claimed that opacities on the films in tuberculosis usually appeared later and were manifest only after the disease had already made some progress. He stated that absolute reliance could not be placed on the rule advocated by the author. Radiologic findings should be confirmed by further urologic examination. The President praised the value of stereoscopic and lateral roentgenograms. He found that early tuberculosis was detectable only by means of the cystoscope and confirmed by the bacteriologic findings. The radiologist and clinician should work together and not independent of each other, in order to secure the best results.

Dr. Scott closed by maintaining that to him renal localization was still of value, even if the kidney were fixed. He did not claim that his method should replace pyelography, but that it had been of the greatest diagnostic value in the detection of early tuberculosis. Stereoscopic methods in his experience were of little value, except in the examination of ureters with an opaque bougie *in situ*. That localization was infallible he had not meant to

imply. He agreed with the President that co-operation between the urologist and radiologist was of great importance.

DAVIS H. PARDOLL, M.D.

MASTOID

How shall we Evaluate the Various Manifestations of Acute Mastoiditis? Ben L. Bryant. *Laryngoscope*, November, 1930, XL, 809.

After discussing several laboratory tests, including bacteriology of material from draining ears, lumbar puncture, blood sugar, total and differential white cell count, etc., the author states: "There are many laboratory examinations which are not only useful but essential in the proper evaluation of a case of acute mastoiditis. To some of these, the years have added increasing value; some have decreased in importance. It would seem that the roentgenographic examination has, in a good many instances, held an unjustifiably high position, because, in the final analysis, its chief value seems to be in determining the state of pneumatization, and only by repeated serial plates can one hope to gain much information as to the actual degree of destruction which the interior of the mastoid has undergone."

This impression is amplified earlier in the article. He says it is an established fact that there are widely varying anatomical conditions existing in the mastoid process. There are variations, ranging from the sclerotic through the diploic and irregularly pneumatized to the extensively, ideally, regularly pneumatized mastoid process. The two mastoid processes of one individual frequently vary, although if they are of the pneumatic type they are practically always nearly identical.

A further difficulty to X-ray interpretation is brought out by the results of investigation by Knick and Witte, who found that about one-third (8) of a series of 25 patients who had suffered with otitis media in childhood had a definite restriction of pneumatization of the mastoid cells.

H. RUDISIL, JR., M.D.

MEASUREMENT OF RADIATION

Short Wave Length Radiation: Present Standards for Measuring Quantity and Quality. Francis Carter Wood. *Jour. Am. Med. Assn.*, May 23, 1931, XCVI, 1753-1757.

The exact measurement of roentgen rays is primarily of importance in therapy in order to prevent damage to the patient's skin and to estimate the maximum effect on the tissues to be treated. The quantities of radiation used in radiography are usually so small a fraction of a skin erythema dose that there is little risk of producing any damage to the skin, unless exposures are repeated at too great frequency. It is always wise to ask whether a patient has recently had an X-ray exposure. Legal responsibility will be obviated by careful inquiry. In fluoroscopy, a rough approximation of the erythema dose should be known, and the patient, as well as the operator, should be exposed for the minimum time that will permit the necessary observations. Every record sheet, either for treatment or for radiography, should record former radium treatment or X-ray exposure, exposure to light, an application of any substance to the skin, or the taking of any medicine.

In a general way the effects of radium are estimated largely by direct methods in contrast to roentgen rays, in which the measurements are often indirect. Because of technical difficulties, it has not yet been possible to accurately measure radium in terms of roentgens.

C. G. SUTHERLAND, M.D.

The Dependence of the Wave Length of Small Ionization Chambers ("Thimble Chambers"). Heinz T. Meyer. *Strahlentherapie*, 1931, XL, 576-589.

The dependence of the wave length of thimble ionization chambers was studied after the addition of Si, Al_2O_3 , MgO, and BeO, to the wall material. The amount of the various substances necessary to be added to the basic chamber material (graphite) in order to obtain wave length independence within a half value layer in copper of from 0.15 to 2.0 mm., was determined. The results of these investigations led the author to the conclusion that not

the effective atomic number of the wall material, as stated by Fricke and Glasser, is the controlling factor, but for a certain shape of chamber a definite number of electrons must be present in the chamber material per unit of volume. The average sensitivity of the chambers, assuming equal volume, is slightly dependent upon the wall thickness and also upon the pressure under which the chambers were made. A slightly pressed porous chamber is less sensitive than a heavily pressed and less porous chamber of equal composition. Chambers with thin walls are less sensitive than those with thick walls.

ERNST A. POHLE, M.D., Ph.D.

MEDICAL PRACTICE

The Present Status of Physiotherapy. The Publication Committee, Canadian Radiological Society. *Can. Med. Assn. Jour.*, March, 1931, XXIV, 409.

Due to the necessity of returning the casualties more quickly to active service, and to the necessity of reducing pensional disability to a minimum, modern physiotherapy found its great impetus during the war. Thousands of technicians were trained to administer treatment by physical agencies under the direction of many medical men specially and intensively trained to direct this work. Under all this stimulus, physiotherapy has now become known as a science as well as an art, and gained world-wide professional recognition. Our largest medical schools have begun to teach their undergraduates the principles on which this subject is based. It is being employed in every mental institution and sanatorium and every pretentious hospital—private, civic, or military—in America. It has received professional recognition by the American Medical Association through its Council on Physiotherapy.

A hasty glance over the field of accomplishment may serve to call to mind that physiotherapy has definite conquest to its credit. In the treatment of malignant diseases, no other single measure surpasses radium in value. In the treatment and diagnostic fields, the X-ray has no near competitor. The testimony of all

sanatoria is proof of the value of sunlight therapy in disease processes. The infra-red ray has possibly relieved more pain than any other single measure. That diathermy can localize heat and influence deep-seated lesions is not seriously questioned to-day by anyone who has made adequate inquiry. In the static current, we have a method of decongestion that has no peer. If massage is indicated, the faradic, sinusoidal, and Morton wave currents will stimulate to function every tissue that has a contractile element in it. The field of galvanism beneficially influences chronic, painful, and degenerative conditions better than any other method of attack which we possess. Hydrotherapeusis will favorably influence any pathologic state.

L. J. CARTER, M.D.

The Relation of Radiology to Other Branches of Medical Practice. Arthur C. Christie. *Jour. Am. Med. Assn.*, May 23, 1931, XCVI, 1747-1749.

The roentgen ray was discovered in 1895, and radium, in 1897. The entire history of radiology, therefore, covers a period of only about thirty-five years. There are no sound reasons, either scientific or economic, for giving radiology a status different from that of other specialties. The same considerations govern here as in other fields; namely, the limitations imposed by practical conditions. Various types of limited radiologic practice are discussed in detail. The position of radiology in schemes of organization is considered.

Roentgenology occupies so broad a field, its technical difficulties are so numerous, and interpretation requires so broad an experience that it constitutes a special branch of medicine. The interests of patient and profession are best conserved when it is so practised.

C. G. SUTHERLAND, M.D.

Rational X-ray and Radium Therapy. Walter A. Weed. *Jour. Florida Med. Assn.*, October, 1930, XVII, 164-167.

The author presents conclusions drawn from sixteen years of experience. The indications

and contra-indications for the therapeutic use of radiant energy are very clearly defined. The radiologist should above all else be unprejudiced, and should be the first to recognize not only the definite indications for his services, but should know his limitations as well. He must know not only the physics of X-ray and radium and the principles of dosage, but should be somewhat of a mechanical genius in order to apply his remedies in the best manner. A combination of X-rays, radium, and electrocoagulation in judicious, experienced, and skillful hands constitutes one of the greatest known weapons in combating certain conditions. The radiologist, with 100 mg.-min. of radium, in addition to a modern X-ray therapy machine and a diathermy apparatus, and who knows how to use them conjointly and separately, can show results comparable to those obtained in large institutions. The X-ray can supplant, for all practical purposes, the use of radium, except in cavities and in treating nevi.

W. W. WATKINS, M.D.

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Before 1910, it may be said that roentgenology was used chiefly in relation to traumatic and organic lesions of bone and to the pulmonary and cardiac apparatus. The period between 1910 and 1920 was featured mainly by improvements in apparatus and technic, and these were reflected in wide extension of the method to numerous phases of clinical medicine. The outstanding contributions of the decade were related to the gastro-intestinal tract and were made possible by the advent of the opaque meal. Cystography and pyelography made their appearance, and recognition of many lesions of the urinary system became more and more a matter of training and experience.

During the last decade, radiology has advanced more rapidly than ever before. Cholecystography, roentgenography of structures or organs injected with iodized oil, roentgenography after insufflation of gas or air, and intravenous urography have come to facilitate

the diagnostic and therapeutic task of the physician.

The development of radiotherapy has also been marked by rapid progress.

Radiology, as a career, furnishes the best opportunity in medicine to-day—a fresh, fertile, and uncrowded field—in which the ambitious and well-trained young physician can make an enviable place for himself more rapidly than in any of the older branches.

C. G. SUTHERLAND, M.D.

RADIATION SICKNESS

Safety for Radiologist and Patient in Diagnostic and Therapeutic Radiology. Henry K. Pancoast. *Jour. Am. Med. Assn.*, May 23, 1931, XCVI, 1757-1760.

The discovery of the therapeutic properties of X-rays was the outcome of the observation of damage to tissues as the result of prolonged exposure. Death took a heavy toll among the pioneers. Protective measures have had to be devised for those who work with X-rays and radium.

The development of high-powered equipment and the autotransformer control have supplied the additional danger of electrical shock. The film fire hazard has become a more recent menace. The undesirable and annoying "irradiation sickness" can be controlled in a measure, but cannot be altogether avoided.

Excessive irradiation is discussed from the standpoint of the patient and the operator. The author goes into detail concerning electrical shocks, factors in protection against shocks, and the danger of explosive anesthetics being employed in rooms in which open high tension apparatus is used.

The annoying symptoms of roentgen sickness may be minimized by various measures. Radium protection requires care in handling, rotating service for workers, and complete blood counts at regular intervals.

C. G. SUTHERLAND, M.D.

Protection of Patients and Operators from X-rays. Francis Carter Wood. *Jour. Am. Med. Assn.*, May 23, 1931, XCVI, 1760-1762.

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tories which manufacture X-ray tubes have died from cancer of the skin, due to the lack of knowledge of the dangerous effects of continuous exposure to X-rays, even of long wave length. This danger is now obviated by the remote control which is possible with modern tubes. Sterilization and anemia are still possible. In addition to the danger of either direct or scattered radiation, the air of the rooms in which high voltage currents flow may become contaminated with ozone and nitric oxide fumes, the inhalation of which is deleterious to the health of the personnel and may make sensitive patients ill. Methods of protection are discussed in detail. The efficiency of the protective devices should be examined at installation and frequently thereafter. If fluorescence can be noted with a fluoroscope fitted closely about the eyes, a dangerous amount of radiation is present. Scattered radiation should be checked by carrying a dental film, half-covered with lead, over a period of two weeks.

All persons engaged in radiologic work should have a thorough medical examination at least once a year, and complete blood counts should be made every other month. Any marked diminution in leukocytes or hemoglobin is an indication for a prolonged holiday until the condition is remedied.

A copy of directions for the Schaefer method of artificial respiration should be posted in the radiology department. Any one receiving an electrical shock may die from paralysis of the respiratory center.

C. G. SUTHERLAND, M.D.

RADIUM

Short Survey of Radium Treatment. Arthur Burrows. Jour. of Cancer Research Committee of University of Sydney, February, 1931, XI.

This is a survey of the current practice in radium treatment, with a short preliminary statement of biologic principles. Radiosensitivity refers to cells and not tumors as a whole, and hence, as in some of the round-celled sarcomas, although the growth disappears under treatment, it soon recurs when

treatment is stopped, showing that some of the cells are radiosensitive while others (possibly forms of parent cells) are little influenced and burst forth into growths once more. It was for this reason that the French and Belgian "long time" technics were introduced.

Radiologic treatment is best applied to tumors growing in normal healthy tissue, and it is possible that those growing in tissues with a strong tendency to the formation of fibrous tissue or in the midst of fat will not respond so well to radium treatment. Favorable tumor sites are: the front part of the tongue, the skin, and the cervix of the uterus, not only because of the radiosensitivity of tumors growing in these locations, but also because of their accessibility.

Treatment of the nasal sinuses may be carried out by transirradiation, but, as a rule, it is advantageous to lay them open surgically and convert them from internal to external lesions. Direct methods are inadvisable in the larynx. There is no satisfactory technic for the cancer of the bladder, but the burying of small unscreened radon tubes is suggested. With cancer of the breast, treatment of a widespread nature should be employed, even though the burying of needles may have produced a good local result. The opinion is stated that the future treatment of carcinoma of the breast may be by means of X-rays rather than radium. Operation after irradiation of mammary cancer has advantages and, if performed soon enough after radiation, prevents troublesome fibrosis, although the sealing of the lymphatics would then be imperfect. Carcinoma of the prostate is best treated by needling, *via* the perineum or bladder, supplemented by X-rays.

Amputation is recommended for osteogenic types of bone sarcoma; radiation, perhaps followed by surgical operation or injection of bacterial toxins, for the endothelial and plasma-cell types, while radiation alone without amputation or curettage is recommended for giant-celled sarcomas.

The Heyman, Regaud, and Donaldson technics for treatment of carcinoma of the

cervix uteri are reviewed. In carcinoma of the body of the uterus, the "long time" technics are perhaps not so essential and X-rays may be more effectual.

Radium implantation methods, although usual, are not advised for epithelioma of the vulva, owing to the proximity of bony prominences and the liability to sepsis. External radiation, at a distance of two or three centimeters by use of molds of dental compound, a difficult method in actual practice, or "bomb" methods are desirable. Diathermy and surgery should be considered. In any case, the treatment of the glandular areas of the groin is essential.

Unexplained or non-malignant uterine hemorrhage should be treated with minimal doses, even though it is possible that the treatment may have to be repeated. After the menopause, larger doses may be employed. Uterine hemorrhage in exophthalmic goiter requires treatment of the thyroid; of the uterus only as a last resort. Pelvic pain is not relieved by radium, although the partial or complete temporary suspension of the menses in intractable dysmenorrhea may cure pain of this type, particularly if the periods are excessive.

J. G. STEPHENS, M.D.

Theoretic Foundations of a New Technic for Homogeneous Irradiation with Gamma Rays. G. G. Palmieri. *Strahlentherapie*, 1931, XL, 470-492.

The author believes that the homogeneous irradiation of malignant tumors as proposed by Dessauer, in 1904, is the method of choice. While it is used a good deal in roentgen therapy, too little consideration has been given to that method in radium therapy. In his paper he shows how, with proper arrangements of several radio-active centers, the homogeneous treatment of tissue may be carried out. Experimental proof for his theoretical deduction and detailed data for the treatment technic in typical cases will soon be published.

ERNST A. POHLE, M.D., Ph.D.

Elimination of Radium Salts from the Human Body: Preliminary Report. Frederick B. Flinn. *Jour. Am. Med. Assn.*, May 23, 1931, XCVI, 1763-1765.

It has been shown that soluble and insoluble salts of radium were eliminated whether they had been ingested orally or injected intravenously.

Persons who have received repeated internal doses of radium salts have also been found to be radio-active several years after cessation of treatment. These observations show that there are some people who, because of personal physical conditions or improper diet, have a tendency to store radium in their bones. An analysis of the excreta of these persons indicates a low rate of elimination. This is a preliminary report in the use of viosterol to increase the rate of elimination. The author hopes sometime in the near future to report a complete elimination in all cases and to present roentgenograms showing an improved condition of the bone.

C. G. SUTHERLAND, M.D.

Our Experience with the Injection of "Beta Radiators" in Malignant Tumors. Hellmut Kamniker. *Strahlentherapie*, 1931, XL, 427-437.

Loeb and Wreschner prepared an iron hydroxid Uran-X compound, with a half decay period of 24 days, for injection into accessible malignant tumors. The author tried it in a series of far-advanced cases and came, after analyses of the respective histories, to the following conclusions: The "beta radiators" are very effective and a welcome help in the treatment of carcinoma, particularly in cases in which, for anatomical reasons, the application of radium element is impossible. Injections should not be given in deep-seated malignancies, because otherwise there might result a perforation of the necrotic tumor into cavities or neighboring organs. Sometimes it is advisable to inject an area from the edge to the center of the tumor, in order to guarantee drainage of the necrotic material. This may also later on permit the application of screened radium. Repeated injections at short intervals are contra-indicated. No undesirable re-

actions were observed either in the kidneys or in the blood. Histologically, necrosis of the tumor can be seen. Clinically, the injected tissue usually undergoes liquification and is, in favorable cases, replaced by scar tissue.

ERNST A. POHLE, M.D., Ph.D.

So-called Late Reactions Following Radium Treatment in Gynecology. St. Liebhart and E. Meisels. *Strahlentherapie*, 1931, XL, 508-514.

The author first discusses briefly our present opinion concerning late injuries following irradiation. He then reports a case which was observed in his clinic. A woman of 59 years was treated for carcinoma of the cervix with roentgen rays and radium, beginning in April, 1927. Sixteen X-ray treatments of 6 H units each, and a total of 3,600 mg.-hrs. of radium were applied. The carcinoma healed, and in July, 1928, a whitish, glossy scar was seen in the vagina. In June, 1929, the patient returned, complaining of severe back pain and tenesmus. She had lost weight and felt rather weak. In the posterior wall of the vagina a diffuse infiltration was seen, with an ulcer about the size of a quarter. Biopsy showed a histologic picture very suspicious of a recurrence. However, from a clinical standpoint, this ulceration was interpreted as a probable late reaction and treated accordingly. Four weeks later the ulceration had healed, and in April, 1930, the patient was still well.

ERNST A. POHLE, M.D., Ph.D.

The Technic of Radium Therapy To-day. Duncan C. L. Fitzwilliams. *Brit. Med. Jour.*, Aug. 30, 1930, II, 309-311.

The ideal method of radium application, namely, the introduction of radio-active substances which will circulate through the body and act on the primary growth, is at present beyond our powers, and we are limited to the introduction of radium foci locally. The use of radium has now reached a position where we know that in the treatment of carcinoma it is on a par with surgery. It is introduced locally in seeds, needles, tubes, or bombs. The different methods of application are discussed, *viz.*: (1) The intra-cavitation method; (2)

the interstitial method; (3) surface irradiation; (4) distance radiation.

In the use of radon, accurate dosage is difficult, as it is not always known when it was prepared. In twenty-four hours it loses 18 per cent of its power, and in three days, 50 per cent.

The author discusses dosage and the way it has been revolutionized by the work of Professor Regaud, of Paris, who has influenced us to use smaller doses over longer periods of time. Radium acts best in a virgin soil, but if the second dose follows after only a very short interval, the same good results are seen. While the immediate effects of radium therapy are well known, there are remote results which are not understood. The tissues are altered in such a way that some quite slight injury may cause necrosis and death. For instance, he warns against such irritations as result from dental plates or too hot baths.

The chief limits of radium treatment are inaccessibility and late diagnosis. Also, some carcinomas, as in the body of the uterus, are resistant to radium. The treatment requires the knowledge and experience of a specialist, and it is a remarkable fact that radium therapy has survived in spite of the indiscriminate distribution of radium and radon about the country.

W. D. MACKENZIE, M.D.

Radium Treatment of Epitheliomas of the Skin. Roy Ward. *Brit. Med. Jour.*, Sept. 27, 1930, II, 511-513.

The results of treatment of 1,773 cases of rodent ulcer by radium at the Radium Institute, London, are reported. Of all cases, 77 per cent are reported as cures. Of 240 cases that had previously become refractory to X-rays, 102 were healed as a result of radium treatment.

As biopsy tends to activate the growth, it is done only to confirm diagnosis in doubtful cases. In the treatment the fundamental principle is to estimate the dose sufficiently to bring about the death of all the malignant cells without impairing the vitality of the surrounding normal tissue, so that healing may take place satisfactorily.

Small hypertrophic growths mobile on the underlying structures should be treated by surface radiation from an unscreened full-strength applicator containing 5 mg. of radium element per square centimeter. All crusts are first removed and the surrounding skin is protected by rubber-covered lead sheeting. Exposure lasts from one to two hours, according to the thickness of the lesion. When it is necessary to limit the irradiated area on account of the proximity of especially sensitive organs, it is advisable to use buried radium in the form of screened seeds.

In large hypertrophic growths, in order to obtain homogeneous distribution, it is necessary to use screened apparatus—for example, needles buried in and around the growth—and no part of the growth should be farther than one centimeter from the source of irradiation. Also, more massive doses should be placed at the periphery, in order to obtain a homogeneous distribution.

In the superficial ulcerative variety the treatment is similar to that of the hypertrophic growths from which they have originated.

In the superficial cicatrizing variety, unscreened radium plaques are used, and it is necessary to irradiate a considerable distance beyond the visible margin of the growth, as outlying columns of cells are undoubtedly present in these locations.

In the deep ulcerative variety we have the most severe form of basal-celled epithelioma and the most difficult to treat. Gamma radiation must be used; beta radiation with unscreened or lightly screened radium is not suitable. In order to avoid the disadvantages of prolonged exposures on the one hand, and insufficient amounts of screenage on the other, much larger amounts of radium, screened through a minimum of 2 mm. of lead or its equivalent for a comparatively short period, are employed. In addition, means must be found to absorb the secondary radiations, and sometimes this is done by the interposition of Columbia wax or sorbo rubber, a measure which also provides a more homogeneous dose, by the distance which is created between the radium and the lesion. With this technic the

duration of treatment varies between forty-eight and seventy-two hours. If the time is increased beyond a total of seventy-two hours, damaging effect may be produced, especially in old persons. (Recently the use of needles or screened seeds has in some cases replaced or supplemented surface treatment.) If, however, bone or cartilage has been invaded, an even shorter exposure will be advisable, since these structures, especially when devitalized by the invasion of the neoplasm, have a great tendency to radium necrosis. About one-third of the treated cases healed.

As to the question of repetition of irradiation treatment, there is no doubt but that it is best to give the maximum dose at the first treatment, for after each successive dose the rodent ulcer becomes more refractory to treatment. On the other hand, a growth which has proved refractory to beta irradiation will often respond to gamma radiation. Previous treatments produce an avascularity of the tissues, rendering them more susceptible to radium necrosis, and, therefore, thicker screening may be necessary for further exposures.

Radium should never be employed within six weeks of any previous treatment. Details of any previous treatment, X-ray or radium, its dosage and subsequent reaction, must be taken into consideration when estimating a given dose, if "radium burns" are to be avoided. The term "radium burns" is not applied to the simple vesication and ulceration which follow upon an unscreened radium exposure and which are essential parts of the reaction, but is reserved for those few instances in which the dosage has been excessive and the resultant ulceration is extreme in degree, with severe persistent pain and slow repair.

The following special points in prognosis are mentioned:

Ulcers in certain situations, such as the forehead, ear, and inner canthus, have a serious prognosis. When a mucous membrane is implicated, the condition also proves more resistant, and is often eradicated only by free excision. When an ulcer becomes secondarily infected it often responds poorly to radium.

In some cases the sepsis appears to be aggravated by treatment, thereby only adding to the patient's discomfort.

Squamous epitheliomas of the skin differ from rodent ulcers in their more rapid growth and their formation of metastatic deposits in the neighboring lymphatic glands. In the early stages of the disease, the results of excision with the radioknife are so good that radium should be reserved for the more extensive cases.

WALLACE D. MACKENZIE, M.D.

The Use of Radium in Benign Uterine Hemorrhage. Gerard Raap. Jour. Fla. Med. Assn., December, 1930, XVII, 273-275.

The author quotes Howard Kelly as follows: "He who would give his patients the same consideration he would give his wife, or sister, must put radium first in the treatment of fibroid tumors. In uncomplicated fibroids, there is no treatment quite so satisfactory."

Among the benign pathologies of the uterus amenable to radium, most of them at some stage are complicated by hemorrhage, and among those in which radium is indicated the author mentions: Uterine fibroid; metrorrhagia and menorrhagia; hemorrhage of climacteric; endocervicitis and cervicitis, and surgical conditions in which the control of hemorrhage is essential to surgery. Ovarian extracts are used to control the symptoms during the induced climacteric. Estrogen is mentioned as a probable improvement over extracts heretofore available.

W. W. WATKINS, M.D.

Further Observations on the Use of Radium in the Control of Subcutaneous and Mucous Membrane Hemorrhage by Irradiation of the Spleen. J. M. Hoffman. Jour. Fla. Med. Assn., December, 1930, XVII, 265-268.

In a previous communication the use of this method in cases of hemophilia, purpura hemorrhagica, and hemorrhagic disease of the newborn was reported. Three additional cases are cited in this paper. If the blood volume

is low, the method should not be used, but blood transfusion. The technic recommended is as follows: 50 mgm. of radium in a large brass capsule placed at one-inch distance from the skin over the spleen, with a dosage of from 300 to 400 milligram-hours.

W. W. WATKINS, M.D.

ROENTGENOTHERAPY

X-ray Therapy of Inflammatory Conditions. Klövekorn. Schweiz. med. Wchnschr., April 25, 1931, LXI, 408.

In chronic adnexal inflammatory processes, the author applies a dose of 150 r three times, at eight-day intervals. For furuncles of the upper lip, nose, and external auditory canal, he has applied from 80 to 100 r. In mastitis of infants, a maximum of 10 per cent S. E. D. produces astonishing results. A somewhat larger dose is necessary in adults. Good results follow the early irradiation of paronychia. The results of the treatment for erysipelas are questionable. Phlegmons and pararitria should not be irradiated.

H. C. OCHSNER, M.D.

The Differential Action of X-rays on Tissue Growth and Vitality (Part 1). Warnford Moppett. Jour. Cancer Research Committee of University of Sydney, February, 1931, II. (Reprinted from Proc. Royal Society, London, B, CV, 402.)

This is an important paper, giving the results of four years' research. The work is of unique interest although it awaits the confirmation of other investigators.

A feature of the investigations was the use of X-rays reflected from a calcite crystal. Thus, a far higher degree of monochromaticity was secured than could be obtained with the use of filters, as has been the case in most other experiments on the effects of X-ray of various wave lengths.

Three important results are stated:

(1) Almost purely monochromatic X-rays of not very different wave lengths may produce vastly different biologic effects.

(2) X-rays of different wave lengths may exert antagonistic biologic effects.

(3) Small doses of almost purely monochromatic X-radiation of certain wave lengths produce stimulation of tissue growths and hypertrophy, while larger doses of the same wave length produce atrophy.

The tissue investigated was the chorio-allantoic membrane of the chick, which presents a vascular mesenchyme enclosed by two layers of epithelium. It is thus an embryonic tissue, a restriction which should be borne in mind.

The technic consisted in removing a portion of the shell of fertile eggs which had been incubated from eight to nine days. Through this window, about 8×16 mm. in size, the non-living shell membrane immediately beneath the shell was displayed. During the irradiation, the eggs were contained in a small incubator, and the detached portion of shell was sealed in position with paraffin wax after the experiments. After further incubation for four days, the specimens were examined macroscopically and microscopically.

With the aid of a physicist, W. H. Love, almost purely monochromatic radiation was obtained by reflection from a calcite crystal, the monochromaticity being limited only by the width of the slit.

The degree of resolution of the radiation may be inferred from the fact that experiments were performed at 0.32 \AA. , 0.36 \AA. , 0.42 \AA. , etc., and at similar intervals over the entire spectral range, from 0.32 \AA. to 2.00 \AA. It should be noted that this range is softer than that employed in deep therapy practice. A harder wave length range, from 0.1 \AA. to 0.3 \AA. , is mentioned and shown in a diagram, but it is not discussed and apparently refers to an earlier paper.

By employing the white radiation from the target and avoiding its spectral lines, it was possible to secure equal intensities of radiation at each of the wave lengths. Details not mentioned by the author are that the X-ray tube was an air-cooled Coolidge therapy tube energized by a Gaiffe-Gallot constant potential machine.

The energy or intensity was checked by two independent methods of measurement, the

ionization and the photographic. A constant time of exposure was employed, thus eliminating various time-factor complexities. Over the wave length range 0.32 \AA. to 0.8 \AA. the exposure time was two hours, but for other wave lengths it was not stated. In order to observe the effect of lesser dosage, a moving shutter was arranged so that, although the total time of exposure was two hours, certain portions of the membrane could be screened for a greater or less time during the exposure.

Altogether 680 eggs were exposed, and, subtracting those in which the embryo died, the author states that "about 440 experiments were determinants." Controls without X-radiation were employed at every stage of the investigation and in each case gave negative results.

The results obtained are uniquely interesting. The diagrams and statement of these results are, however, difficult to follow and require prolonged perusal.

(1) Every wave length in suitable dose produces hypertrophy; there are no ineffective wave lengths.

(2) Increase in dosage at certain narrowly defined wave lengths produces atrophy, while at all other wave lengths hypertrophy alone can be produced, even when the dose is greatly increased.

For example, with a dosage time of two hours, hypertrophy is produced at 0.48 \AA. , atrophy at 0.53 \AA. , hypertrophy at 0.64 \AA. , and atrophy at 0.8 \AA. Increase in dosage time does not alter this relationship, whilst decrease causes hypertrophy at 0.53 \AA. and 0.8 \AA. and no effect or very slight hypertrophy at other wave lengths. Atrophy is thus a specific effect which can be produced at certain definite regions only, notably 0.53 \AA. Hypertrophy manifests itself as a raised plaque, atrophy as a punched-out ulcer.

It is significant that the atrophy-producing wave length 0.53 \AA. with the width of slit employed would include the *L*-absorption edge of uranium, the wave length 0.8 \AA. corresponding approximately to the *L*-absorption edges of lead, while the hypertrophy-producing

wave length 0.64 would include the *K*-absorption edge of molybdenum. Traces of these metals were demonstrated chemically in eggs of the same batch in collateral researches by Bishop and Mankin. Thus, it may be possible to interpret the selective effect as arising from photochemical sensitization of the membrane to certain wave lengths.

(3) The author also finds evidence of specific stimulation of individual tissues, such as epithelia, by particular wave lengths.

(4) The most remarkable of the results obtained, however, is the fact that when the chorio-allantoic membrane was exposed to the full unfiltered radiation from the X-ray tube for a period of fifteen minutes, no biologic changes whatever were detected. And yet measurements showed that the intensity of the full beam was approximately one thousand times that of the monochromatic radiation (reflected from the calcite crystal) which caused atrophy. No obvious flaw is to be seen in the author's statement of his experimental technic. It is regrettable that the voltage and milliamperage energizing the tube are not stated, and that no dose in human erythema units is stated, or even an approximation.

Inquiry elicited the information that the tube conditions were: 60 K.V., 4 ma. target-membrane distance 35 centimeters. Thus, for the fifteen minutes' exposure the dose of heterogeneous rays on the membrane was probably less than a human erythema dose. This produced no effect. It is extraordinary that with monochromatic radiation of only one-thousandth, the intensity of the heterogeneous radiation from which it was derived should produce atrophy. For a two-hour exposure the dose would thus be only one-one hundred and twentieth that of the mixed beam, which was ineffective in fifteen minutes.

The hypothesis of antagonistic effects of different wave lengths is put forward to explain the above effects. Confirmatory evidence was found in the fact that widening the slit and thus decreasing the degree of monochromaticity when employing an atrophy-producing wave length "tends to neutralize the reaction."

Moreover, the fact that no effect could be produced in the membrane with the shell intact is explained as being due to the antagonistic effect of the radiation scattered by the shell interfering with the monochromatic radiation. Controls in which the window was removed for several hours and replaced without irradiation showed no effect. Controls in which the window was removed for two hours, then replaced, and then irradiated would seem to be desirable, however, rigorously to exclude the summational effect of two irritants—irradiation and window-making.

Further, a preliminary exposure to the full mixed radiation of the tube for ten minutes completely prevented the production of any reaction whatever when the same membrane was immediately afterward exposed to the atrophy-producing monochromatic beam for the usual period of two hours. Strangely enough, the reverse procedure does not interfere with the atrophy; that is, when the mixed beam is applied after the monochromatic beam.

Other experiments showing the antagonism of different wave lengths are described. The occurrence of the typical membrane reactions when all of the contents of the egg (but not the shell) are interposed in the path of the monochromatic X-ray beam is of great importance clinically, because this shows that if monochromatic radiation could be applied to a patient, the scattering caused by soft tissues between the skin and a tumor would not debase the purity of the beam to an extent that would neutralize the specific wave length effect.

The work awaits confirmation by other investigators.

J. G. STEPHENS, M.D.

Roentgenotherapy of Hypertrophy of the Prostate. J. Grünthal. *Röntgenpraxis*, April 15, 1931, III, 364-370.

The roentgenologic treatment of prostatic hypertrophy has been reported by many authors. They do not all agree as to the results. Grünthal has applied roentgenotherapy in 26 cases, which were inoperable on account of

complications (20) or refused operation (6). Sixteen cases had a complete retention; 12 of these (75 per cent) were successfully treated, and could urinate again without having to use a catheter; while in three of these, two treatment series were necessary. A complicating cystitis was not aggravated. The patients have been followed up from six months to three years. One must apply from 95 to 100 per cent of a skin erythema dose to the prostate, and not only from 70 to 75 per cent, as so many have done.

The author's technic was as follows: 200 K.V., a filtration of 0.8 mm. Cu, from 4 to 6 fields of from 8 to 10 and 10 to 15 square centimeters, and an effective dose of from 90 to 100 per cent of a skin erythema on the prostate.

Tabulations with histories of patients, findings, treatment dates, and results are given.

H. W. HEFKE, M.D.

Alterations in the Blood Calcium Level after Radiotherapy. Langeron, Desplats, Paget, and Guémère. *La Presse Méd.*, March 28, 1931, XXXIX, 457.

X-rays were applied to the suprarenals and the cervical sympathetic. The irradiation was followed by an immediate increase in blood calcium, lasting for twenty-four hours, with a fall of varying degrees for several days. The fall was accompanied by a third phase, during which the blood calcium was again increased to or above the previous level. Irradiation of the suprarenals was followed by a greater initial increase, while irradiation of the cervical sympathetic was accompanied by a greater late increase in the blood calcium.

WALTER M. LEVITT, M.B., M.R.C.P., D.M.R.E.

Radiation Therapy in Gynecology. Bickenbach and Haupt. *Schweiz. Med. Wchnschr.*, April 25, 1931, LXI, 408.

The author describes the methods of treatment of metropathies, carcinoma of the vulva, and ovarian carcinoma. In juvenile bleeding, he has had excellent results following the application of from 150 to 175 r to the spleen.

H. C. OCHSNER, M.D.

Curative Deep X-ray Therapy in Prostatic Hypertrophy. P. Lehmann. *La Presse Méd.*, April 8, 1931, XXXIX, 510.

The author believes that medium voltage X-ray therapy gives only mediocre results in prostatic hypertrophy. With deep X-ray therapy, however, provided that the dosage is sufficient, good results are obtained. A series of 36 cases treated during the past six years is referred to, in which subsequent operation has been necessary in only one. Many of the patients had resorted to catheter life before the treatment, and have been well since. Only a brief account of the communication to the Medical Society of Paris is given, and there are no details of the technic.

WALTER M. LEVITT, M.B., M.R.C.P., D.M.R.E.

Leukoplakia Buccalis: A Study of Eighty Cases. Howard King and C. M. Hamilton. *Southern Med. Jour.*, May, 1931, XXIV, 380-383.

Leukoplakia rarely occurs in youth. Tobacco is the most prevalent etiologic factor, syphilis playing a minor rôle. It is resistant to treatment. Leukokeratoses are removed by electrocoagulation, the radium plaque not being used at present, after having been tried and found unsatisfactory. This seems strange because the best results on lip lesions have been secured with X-ray therapy, giving from three to five skin units. Cases in which carcinoma has developed were irradiated with radium and destroyed by electrocoagulation immediately afterwards. Mild lesions of leukoplakia over large areas should not receive strong applications.

W. W. WATKINS, M.D.

Treatment of Surgical Tuberculosis with the X-ray. Janker. *Schweiz. med. Wchnschr.*, April 25, 1931, LXI, 407.

The greater the involvement the greater caution should be exercised. The author gives tabulations governing the amount of irradiation for simple or infected lymphoma. A relatively much lighter dose is given to severe or early infections. The treatment of bone and joint tuberculosis depends upon whether the lesion is open or closed. Closed lesions

are given from 5 to 15 per cent S. E. D., and open lesions from 40 to 70 per cent S. E. D. A filtration of 0.5 mm. Cu, plus 1 mm. Al, and a point gap of from 30 to 40 cm. are used. In spina ventosa, a 5 to 10 per cent S. E. D. is repeated three times, at intervals of eight days, and further treatment may be given in from three to six months. In tuberculosis of the skull, 20 per cent S. E. D. is repeated from six to eight times, at intervals of from three to six weeks. In tuberculosis of the spine, 10 to 20 per cent S. E. D. is given at intervals of from three to six weeks. Further treatment may be given after from three to six months.

H. C. OCHSNER, M.D.

The Treatment of Prostatic Hypertrophy by Deep X-ray Therapy. Guilbert. *La Presse Méd.*, April 11, 1931, XXXIX, 526.

There are reservations to be made in claiming curative value for deep X-ray therapy in prostatic hypertrophy. Cure may be obtained only in the early stages before sclerosis has occurred. The slightest vesical infection is an absolute contra-indication.

WALTER M. LEVITT, M.B., M.R.C.P., D.M.R.E.

SKIN (GENERAL)

The Effect of Sunlight on the Immunizing Function of the Skin. Pierre Woringier. *Strahlentherapie*, 1931, XXXIX, 493.

The author states that there are many clinical observations in favor of the contention that light tends to increase and accelerate the specific reactions of the organism towards infections. As an example, he quotes the fact that in measles, irradiated skin reacts quicker and more intensely than unexposed skin. He assumes that most exanthematous diseases will show similar skin reactions.

ERNST A. POHLE, M.D., Ph.D.

Further Contributions to the Histology of Sensitized Roentgen Irradiated Skin. H.-G. Bode. *Strahlentherapie*, 1931, XL, 515-545.

The histologic changes in the skin of guinea-pigs after the application of tincture of iodine, 10 per cent chrysarobin vaseline, and croton oil, with X-rays alone, and with a combination of X-rays and the above mentioned agents,

were studied. No macroscopic difference could be seen between the areas treated by X-rays alone and those exposed after sensitization. The inflammatory processes produced by tincture of iodine, croton oil, or the 10 per cent chrysarobin vaseline decrease slowly during the first 15 days after the application, and the microscopic picture finally shows almost normal skin. If sensitized skin is exposed to roentgen rays up to 15 days after sensitization, the structural changes are definitely increased, as compared with non-sensitized irradiated skin. The degenerative changes in skin sensitized with tincture of iodine or croton oil have their maximum after roentgen exposure is carried out for 9 or 7 days, respectively, after sensitization. If the skin is irradiated before this interval, there is a steady increase in the intensity of the histologic changes in the sensitized irradiated skin, as compared with non-sensitized skin. The greater the interval between sensitization and roentgen exposure the greater the changes. If, following sensitization with chrysarobin vaseline, the roentgen exposure is carried out later than 5 days afterwards, there is very little difference between the changes observed in sensitized and non-sensitized skin.

ERNST A. POHLE, M.D., Ph.D.

SURGERY

New Technic and Instrument for Obtaining Biopsy Specimens. William J. Hoffman. *Am. Jour. Cancer*, January, 1931, XV, 212-220.

The author discusses the various means of obtaining biopsy specimens and the disadvantages attendant upon these methods. He feels that an ideal instrument for obtaining biopsy specimens ought to satisfy the following requirements:

1. It should be safe.
2. It should not favor the spread of the tumor.
3. It should be simple and sturdy in construction, easily adjusted and assembled, easily cleansed of all tumor tissue, and readily sterilized.
4. It should be possible in nearly all cases to obtain with the instrument a piece of tissue

through a small puncture wound on the first attempt, thus inflicting the minimum of trauma.

5. If a greater quantity of material is desired, it should be possible to obtain it without making a new breach in the capsule of the tumor.

6. It should be capable of removing all types of material.

7. It should be capable of obtaining a sufficient amount of tissue for a complete examination.

8. It should provide some means for sealing the breach in the tumor and killing any tumor cell along the tract of the instrument.

The author believes that his instrument fulfills the above conditions. It consists essentially of a slender steel sheaf, the outer surface of which is electrically insulated, except for a narrow band of exposed metal at one end, which is honed to a cutting edge. The hollow sheaf is built to receive any one of several members designed to puncture a hole, to cut off and grasp a piece of tissue, to withdraw the tissue fragment through the sheaf, and later to coagulate the tract by high frequency current.

In the hands of the author, the action of this instrument is safe and simple. It has been successfully used on many dense fibrous tumors.

JOHN R. CARTY, M.D.

Surgery of the Phrenic Nerve in Treatment of Intractable Hiccup. Carnes Weeks. *Ann. Surg.*, April, 1931, XCIII, 811-815.

In post-operative intractable hiccup, if all the usual methods of treatment fail, the patient should be fluoroscoped to determine which side of the diaphragm is involved. The phrenic nerve on the involved side should then be exposed under a local anesthetic, and a stout silk ligature passed about it. The nerve can then be anesthetized, which may last for as long as eight hours. Following this, traction may be tried, and if it fails the nerve can easily be exposed and crushed. If, at operation, novocaine block and traction prove unsuccessful, this should lead one to believe that

there is nerve anastomosis below the site of section or blocking, and the nerve should then be avulsed. If fluoroscopy shows both sides of the diaphragm to be involved, then both phrenic nerves should be exposed and blocked either temporarily or permanently.

F. B. MANDEVILLE, M.D.

THYMUS (DIAGNOSIS)

Roentgenology of the Thymus in Infancy and Differential Diagnoses of Enlarged Thymus and its Treatment. Henry K. Pancoast. *Am. Jour. Med. Sci.*, December, 1930, CLXXX, 745.

The author has described in this article a very complete method of examining the thymus in infancy. He uses posterior-anterior and lateral views, both at inspiration and expiration, in order to determine the lateral deviation of the trachea, narrowing of the trachea at the thoracic inlet during inspiration, and, if there is more than a normal amount of collapse at the thoracic inlet, at the expiratory phase.

He believes that the diagnosis of thymic enlargement has been based in the past upon erroneous roentgenologic evidence. The only definite and reliable signs of an enlarged or potentially dangerous gland are abnormal narrowing or buckling of the trachea at the thoracic inlet, as it passes over the apex of the gland, and lateral deviation. The unusual width of the gland is apparently of no particular significance, and one producing a narrow shadow is likely to be far more dangerous than a wide one. The roentgenologist must have in mind certain conditions that may confuse the diagnosis, such as asthma, whooping cough, meningitis, and congenital heart lesions; therefore he must exclude any other form of upper respiratory tract obstruction which he may be able to show, such as foreign bodies, obstructive specific laryngeal infections, post-diphtheritic and other forms of acquired or congenital stenosis, retropharyngeal or retrotracheal abscess, adenoids, atelectasis, and unusual collapse of soft tissues.

The treatment of thymic enlargement in infancy is discussed in further detail.

ROE J. MAIER, M.D.

The Thymus. A. Stanley Kirkland. Canadian Med. Assn. Jour., November, 1930, XXIII, 661.

Children with thymic symptoms may be divided into three age groups: (1) Those who have difficulty in the first few hours of life; (2) those whose difficulty appears in the first few weeks of life; (3) those whose persistently enlarged or hyperfunctioning thymus endangers their lives during the years up to puberty or even later.

The first group shows difficult breathing from the start, cyanosis being a conspicuous and persistent symptom. Enlargement of the thymus is nearly always present, and very frequently there is a definite atelectasis.

The second group provides the combination of symptoms which are classically described in all discussions of the thymus. A mild or moderate degree of cyanosis, with difficulty in nursing, are frequently the only indications evident to the careful observer. Convulsions are a common feature. During the convulsions, the cyanosis and dyspnea increase, and the inspiratory cry or crow will often be noted. The cry of the child with thymus enlargement is brassy, mechanical, and often terrifying.

The third group carries only a degree of potential danger. These have a persistently enlarged thymus, and their risk consists in the possibility that they may require the administration of an anesthetic for surgical treatment. A child of this type may die suddenly during primary anesthesia or succumb unaccountably to an apparently trifling infection.

Most observers are agreed that it is impossible to arrive at any conclusion as to the normal size, shape, and weight of the gland. Very exhaustive studies have been undertaken by several anatomists, pediatricists, and roentgenologists, but their efforts have done little to give us a picture of what a normal thymus should be. What is to be taken as the normal thymus shadow? The author feels, with many others, that any shadow appreciably wider than that cast by the vertebral column should be considered abnormal, and certainly any asymmetrical shadow extending over a portion of either lung-field is a matter for serious consideration.

However, the size of the gland shadow is not the chief importance. Thymic hyperfunction or dysfunction is the condition with which we are concerned. Possibly too much stress has been laid on the enlargement of the thymus as shown by the X-ray. It may be granted that the gland sometimes produces symptoms mechanically, by pressing on the very important venous and arterial structures with which it is in contact. Nevertheless, many times the X-ray fails to show any thymic shadow in children, exhibiting typical thymus asthma, who react well to thymus radiation. Again, in others in which a large shadow is found, X-radiation will relieve symptoms, with little or no change in the size of the shadow.

The treatment of thymic disturbance should always be by radiation. The child with an abnormal thymus should receive X-ray therapy as soon as the condition is recognized. This type of treatment has changed what was an extremely fatal condition to one rarely fatal.

There is some difference of opinion as to the relative value of X-ray and radium, both as to therapeutic value and as to ease of application. X-ray is equally easy of application, and is available in many situations where radium is out of the question. The cost of X-ray is less and the results are equally good, if not better.

X-ray treatment should be continued until the symptoms are relieved and then immediately stopped. It was formerly the author's practice to give three treatments over the upper sternum, at weekly intervals: latterly the patients have rarely received more than one or two exposures, chiefly because they began to improve not later than ten days after the first treatment. Again, the necessary number of treatments has been reduced because the clinicians found that by giving calcium chloride in small doses the effect of the X-ray is aided. Occasionally symptoms recur at a more or less remote period, and the treatments may need to be repeated.

L. J. CARTER, M.D.

TUBERCULOSIS (DIAGNOSIS)

Acute Generalized Tuberculosis without Typical Tubercles. William A. Reilly and Zera E. Bolin. *Am. Jour. Dis. Child.*, March, 1931, **XLI**, 582-590.

The authors report the case of an infant in whose blood stream the distribution of tubercle bacilli was followed by lesions. These showed few mononuclear cells, no giant cells, few lymphocytes, and large numbers of polymorphonuclear cells, with many tubercle bacilli in each lesion. The explanation offered for this type of lesion is the large number of bacilli present, coupled with the non-resistance and lack of allergy of the patient.

A roentgenogram of the chest showed a process suggestive of miliary tuberculosis. The individual shadows were somewhat larger than miliary tubercles, and the roentgenologist, at the time of reading the film, believed the picture was consistent with streptococcic bronchopneumonia.

F. B. MANDEVILLE, M.D.

Tuberculosis of the Intervertebral Articulations. Howard P. Doub and Carl E. Badgley. *Am. Jour. Roentgenol. and Rad. Ther.*, March, 1931, **XXV**, 299-307.

In addition to the two commoner types of vertebral tuberculosis, the one being central involvement of the body of the vertebra and the other involvement of the anterior portion of the body, with early bone destruction, the authors recognize a third small group of cases to which they apply the term "intervertebral articular tuberculosis," in preference to the previously given term "epiphyseal tuberculosis of the vertebral body."

Three patients varying in age between fifteen and twenty-five and representing the last named type are presented. The characteristic clinical syndrome was prolonged prodromal stages of repeated attacks of backache, radiating to the sacro-iliacs and down the back of the legs. There was no evidence of kyphosis, but roentgenologically the patients showed definite diminution of one intervertebral space. Two of the cases, showing marked abscess formation, were proven by guinea-pig inoculation with abscess material to be of

tuberculous etiology. The pain symptoms were all below the level of the lesion, hence, thorough, careful roentgenologic study was necessary to establish the diagnosis.

J. E. HABBE, M.D.

A Study of Intestinal Tuberculosis. W. C. Davis. *United States Vet. Bureau Med. Bull.*, April, 1931, **VII**, 344-352.

The author has modeled his technic of studying intestinal tuberculosis after the method of Brown and Sampson. He requests the patient to take no laxative for 48 hours prior to the examination and to abstain from food the morning of the examination. A primary test meal consisting of barium sulphate, cocoa, sugar, flour, and sweet milk is given to the patient at 3 A. M. Fluoroscopic and roentgenographic examinations are made six hours later. The patient is then given a second meal of buttermilk and barium sulphate, which is followed by fluoroscopic and roentgenographic studies at the seventh hour. At the eighth hour a film only is made. Fluoroscopy is done at the twenty-fifth hour after the secondary meal in order that the structures may be identified. A roentgenogram is then made for a record.

The diagnosis of cecal and colonic irritation is based upon evidence of local irritability and general colonic hypermotility, which is indicated by failure of the colon to retain barium for a period within normal limits. A complete study of the colon must include employment of the opaque enema, because of its substantiating value and the possibility of demonstration of spasm lacking in the meal results. In the author's opinion, a definite demonstration of local spasm in the proximal colon without definite colonic hypermotility is sufficient basis for a positive diagnosis.

The most common symptoms observed in intestinal tuberculosis are those resulting from the presence of intestinal gas. The presence of such intestinal symptoms, however, is not considered a reliable basis for a diagnosis. In conjunction with the X-ray they may be of some value. However, a positive diagnosis based upon X-ray evidence is justified even in the absence of gastro-intestinal symptoms.

In the treatment of intestinal tuberculosis, the author stresses especially the great importance of physical rest. A strict diet regimen is not indicated, except in cases in which the clinical and X-ray signs are marked.

J. N. ANÉ, M.D.

Tuberculosis in the Mesenteric Lymph Nodes of Children. Marion Leonard. *Am. Jour. Dis. Child.*, March, 1931, **XLI**, 513-527.

An analysis of the clinical and pathologic records of the New Haven Hospital is made in an attempt to study the incidence of tuberculosis in the mesenteric lymph nodes of children and the association of these nodes with other localizations of the disease. In a series of 161 children under 15 years of age, dying of all causes, there was anatomic evidence of tuberculosis somewhere in the body in 50 cases. Twenty-two of the children were under two years of age. In 28 cases, tuberculosis was considered the primary cause of death, including 19 cases of generalized miliary tuberculosis, 11 cases of tuberculous meningitis, and 7 cases of tuberculous peritonitis. Caseation of the mesenteric lymph nodes was present in 15 patients who died of generalized miliary tuberculosis, and in only three cases was there evidence of calcification of these nodes. Forty-five cases gave evidence of tuberculosis in the mesenteric nodes, 27 showing caseation, 11 caseation and calcification, and 7 calcification without evidence of caseation. Five of the 18 cases which showed calcified mesenteric nodes were in children under two years of age, the youngest being six months old, and all four cases in the group from 14 to 15 years showed calcification of the mesenteric nodes. The remaining 8 cases were in children between the ages of two and 14 years. In 18 cases, tuberculosis of the mesenteric nodes was the only demonstrable tuberculous infection in the body, and no other tissue was found which was the sole site of tuberculosis.

The author concludes that there is a high incidence of tuberculosis in the mesenteric lymph nodes in children, and there is ap-

parently little relation between chronological age and calcification as a pathologic process in children. The intestinal lymphatic system apparently plays an important rôle in tuberculous infection in childhood. The author cites the work of Dunham and Smythe, who noted 21 cases, or 17 per cent, to have roentgenologically demonstrable evidence of calcified mesenteric lymph nodes, in a series of 120 children giving positive tuberculous tests.

F. B. MANDEVILLE, M.D.

Roentgenographic Re-examination of the Chests of Children from Six to Ten Months after Measles. Jerome L. Kohn and Henry Koiransky. *Am. Jour. Dis. Child.*, March, 1931, **XLI**, 500-506.

In a previous paper, the authors reported observations on successive roentgenograms of the chests of 130 children taken during measles. It was shown that shadows suggesting pulmonic infiltration were present in 62.4 per cent, less than four years of age, and in 42.2 per cent, four years of age and over. Abnormal intensity of pulmonary markings, pleuropulmonary changes, and progressive and retrogressive hilum changes were also present.

In this study, roentgenographic re-examination of the chests of 56 children was made from six to ten months after measles. In addition, an interval history was obtained, and a physical examination was made. According to the authors, previous pneumonic infiltrations, even when extensive and of long duration, showed little residual or no pulmonary changes on the X-ray re-examination. These changes, when present, were described as localized accentuation of the pulmonary markings, and abnormal intensity of these markings was no longer seen as described during measles. The authors were under the impression that in 18 cases, pleural thickening, not present during measles, was seen at the site of the interlobar fissure between the upper and middle lobes of the right lung, or in some other portion of the pleura. The density of the hilum shadows appeared to be diminished when compared with films taken during measles. Most children re-

maintained well after discharge from the hospital, and physical examination of the lungs gave normal results, even in patients who had been seriously ill while in the hospital.

F. B. MANDEVILLE, M.D.

Subacute Miliary Tuberculosis: Fatal Case in an Infant, with Roentgenologic Evidence of Healing. J. S. Uhr. *Am. Jour. Dis. Child.*, December, 1930, XL, 1269-1275.

Although miliary tuberculosis is nearly always fatal, the author has reviewed the literature and found reported roentgenologic and clinical observations which show that the disease is not always rapidly fatal and that healing and recovery may occur.

A case of miliary tuberculosis of the lungs in a child is presented by the author. Four chest roentgenograms taken during the course of the disease and showing extensive miliary infiltration of the lungs are included. From the mild course of the disease, as shown by the temperature curve, weight curve, absence of signs and symptoms, the five and one-half months' duration, and clearing up of the disease in the left lung, the author believes that he was dealing with the subacute rather than the acute form of miliary tuberculosis.

F. B. MANDEVILLE, M.D.

Tubercle Bacilli in Children with Erythema Nodosum: Demonstration by Gastric Lavage. Arvid Wallgren. *Am. Jour. Dis. Child.*, April, 1931, XLI, 816.

Children with erythema nodosum who give positive tuberculin reactions often excrete tubercle bacilli. These children seldom bring up sputum: the sputum and bronchial mucus that eventually are produced through irritation from the primary focus are swallowed. The tubercle bacilli must be looked for in the stomach. The author used Meunier's method and examined 40 children with erythema nodosum, all but three of whom reacted positively to tuberculin. Seventeen of the 37 who reacted positively to tuberculin, had tubercle bacilli in the gastric contents.

In the majority of cases with positive tuberculin reactions, there were more or less en-

larged hilar shadows noted on roentgenograms. Roentgenograms of three cases are included in this paper. In the author's opinion enlarged hilar shadows in the positive cases are of tuberculous etiology, and the children are really suffering from tuberculosis. He regards his work as an argument in favor of the tuberculous nature of erythema nodosum.

F. B. MANDEVILLE, M.D.

Chronic Hyperplastic Tuberculosis of the Colon. Samuel J. Goldfarb and Marcy L. Sussman. *Am. Jour. Roentgenol. and Rad. Ther.*, March, 1931, XXV, 324-329.

The hyperplastic form of tuberculosis of the colon is the least common type of tuberculous involvement and is in contrast to the commoner ulcerative type, which is apparently a primary lesion, often with no focus being demonstrable elsewhere in the body. This type of lesion may be found co-existent with typical tuberculous ulcers in the nearby gut. In some cases, it would appear that there is a non-specific ulcerative inflammation of the sub-mucosa, with abscesses, fistulae, and scar tissue, the tuberculosis being in the nature of accidental infection.

The cecum and lower portion of the ascending colon are the commonest seats, although more rarely the distal parts of the colon are involved. All three of the reported cases showed rather extensive involvement at the hepatic flexure region, but two showed also spastic deformities in the terminal ileum and cecum, such as occur characteristically in the ulcerative form of the disease. Two of the three cases were in association with active pulmonary involvement. The authors emphasize the dangers of attempting an etiologic diagnosis of stenosing lesions of the large intestine by roentgen appearances alone.

J. E. HABBE, M.D.

Phthisiogenesis and the Tuberculous "Frühinfiltrat." Hans Staub. *Schweiz. med. Wchnschr.*, Feb. 14, 1931, LXI, 157-161.

Clinical and pathologic anatomic observa-

tions demonstrate that the tuberculous "früh-infiltrat," like all the exudative forms of pulmonary tuberculosis, plays an important rôle in tuberculosis as a disease, whether it involves the infraclavicular region or the middle lung field. Apical tuberculosis, which is accompanied by definite symptoms, is equally important and deserves adequate recognition. Greater progress will be made in the early diagnosis of tuberculosis when both types of lesions are sought for.

H. C. OCHSNER, M.D.

TUBERCULOSIS (THERAPY)

Roentgen Therapy of Pulmonary Tuberculosis. Schulte-Tigges. Schweiz. med. Wchnschr., April 25, 1931, LXI, 408.

Patients with productive fibroid tuberculosis, who are fever-free, or the cirrhotic cavernous types without elastic fibers in the sputum, can be irradiated. Treatment is contra-indicated in fresh infiltrative or active exudative processes.

H. C. OCHSNER, M.D.

Light Treatment in Tuberculosis of Lymph Glands. James W. Thornton. United States Vet. Bureau Med. Bull., March, 1931, VII, 232-234.

The author describes seven cases of tuberculosis of the lymph glands treated by ultra-violet irradiation with apparent cures in the uncomplicated cases, and improvement in those cases associated with active pulmonary tuberculosis. As in the treatment of tuberculosis of other structures, any method of therapy to be successful must be continued over a considerable period of time. Foci of infection should be eradicated and the usual hygienic and dietetic régime adhered to. In uncomplicated cases exercise in the open, in the author's opinion, is of more value than rest in bed. Surgical removal of tuberculous glands is not always successful, as recurrences are frequent. While tuberculin and X-ray therapy have been recommended, these methods were not used in the treatment of the author's cases.

In tuberculosis of the lymph glands associated with active pulmonary lesions, the au-

thor, using the water-cooled lamp with the applicator almost in contact with the skin, applies ultra-violet rays locally to the skin over the affected glands. The initial exposure is of 30 seconds' duration and subsequent exposures are prolonged slightly on succeeding days until the maximum exposure of three minutes is reached. In uncomplicated gland involvement the same procedure is followed and in addition the air-cooled lamp is used for general irradiation, the lamp being placed 36 inches above the patient. The body is divided into zones and each zone is irradiated for three minutes. After several days, or when each zone has had at least one exposure, the time of exposure is gradually extended until a maximum of 20 minutes is reached. The author believes that, with suitable atmospheric conditions, heliotherapy is of still greater value.

J. N. ANÉ, M.D.

TUMORS (DIAGNOSIS)

Sacral Chordoma. James A. Dickson and Charles A. Lamb. Ann. Surg., April, 1931, XCIII, 857-861.

Chordoma is a tumor arising from cellular remains of the notochord, occurring, therefore, along the spine, most frequently at its extremities. It is composed of epithelial tissue and is of endothelial origin. In 1929, reports of only 80 cases had appeared in all medical literature. The average age of onset is from 35 to 40 years, although cases have occurred as early as one and a half, and as late as 79 years. Spheno-occipital chordomas appear, on the average, ten years later than sacrococcygeal chordomas. Males are twice as prone as females to develop these tumors, probably because of the part trauma plays in their etiology. Chordomas are said to have been produced experimentally in rabbits by puncturing the body of a vertebra.

In the case reported, a man 41 years of age complained of pain in the lower part of his back for approximately ten months. Physical, laboratory, and X-ray examinations were negative, except for a tender area about the size of a half-dollar over the lower third of the

sacrum exactly in the mid-line. Rectal examination revealed a bulging area on the anterior surface of the sacrum in its lower third, which was tender and semi-fluctuant. At operation, a tumor mass, yellowish, soft, and very friable, which protruded from the posterior surface of the sacrum and extended to the anterior, was found. The pathologic diagnosis was sacral chordoma. The sacrum was radiated with 900 r-units. Later, on rectal examination, a mass was palpable which seemed to slowly increase in size. On second operation, a bluish-gray tumor mass apparently filled the entire sacral canal but no removal was attempted. Post-operative deep X-ray therapy of five doses of 160 r-units each was given. The tumor decreased in size and became harder and more calcified. The authors feel that the X-ray therapy has been successful in checking this tumor and that metastases are rare in this condition.

F. B. MANDEVILLE, M.D.

TUMORS (THERAPY)

A Tumor of the Mediastinum. R. S. Pentecost. *Can. Med. Assn. Jour.*, March, 1931, XXIV, 452.

This is a case report (by Dr. Pentecost, Dr. Macintyre, and Dr. Richards) of a patient with fibrosarcoma—a small tumor at the base of the epiglottis on the right side filling the pyriform fossa. The patient was referred in 1919 to Dr. Richards for X-ray treatment, which consisted of three series of high voltage X-rays, administered from three portals of entry, right lateral, left lateral, and a central, over the area of the larynx and neck. The technic consisted of 200,000 volts, with 0.5 mm. of copper filter, at a distance of 40 centimeters. The lesion literally melted away, and has never recurred. The patient was carefully followed for five years, and then reported as probably cured.

One month ago—twelve years after the original lesion—the patient returned to Dr. Pentecost, stating that for the past two months he had noticed a stiffness on the right side of his neck, with a feeling of tugging on the muscles, associated with slight coughing. There was no evidence of recurrence of the disease in the larynx or bronchial tree. X-ray

examination of the chest showed a diffuse growth about the size of an orange in the mediastinum. The patient was again referred to Dr. Richards for X-ray treatment.

Dr. Richards' comments on the case are as follows: "Whether this is a recurrence from the old primary lesion or the development of an entirely new sarcoma is at least debatable, and probably is a question which cannot be settled beyond the possibility of doubt. From a study of the films, I am inclined to believe that it is not a secondary in the strict sense of the word. Certainly the X-ray film is not the typical representation of secondary sarcoma, which is usually characterized by multiple lesions, embolic in character, scattered throughout the parenchyma of the lung. The present lesion is a localized one, arising from the hilum of the lung and spreading out from this in a somewhat fan-shaped manner. Its response to treatment may assist in a differential diagnosis. . . ."

Dr. Richards proceeds to discuss the various methods of treatment which might have been used in attacking the original tumor. The choice would be between radium, implanted in the form of needles or seeds, and external radiation in the form of high voltage rays or radium packs. He is strongly opposed to the implantation of radium seeds or needles in any sarcoma. Between radiation, externally by radium packs, and X-rays, there is little to choose.

L. J. CARTER, M.D.

Radiotherapy of Tumors. Schinz. *Schweiz. med. Wchnschr.*, April 25, 1931, LXI, 406.

The author discusses the underlying biologic principles of treatment. The results obtained are due to the cytolethal effect of the rays applied directly to the pathologic tissue. The action is unspecific, but elective action is the basis of scientific radiotherapy. He discusses the methods of radiotherapy including the single massive dose, the saturation method, and the fractional dosage. The basis of the newer forms of treatment is the greater toleration of the skin and subcutaneous tissues to

heavier radiation. A greater effect on pathologic tissues can, therefore, be secured. A detailed description is given of the symptomatic and histologic changes in the skin and mucous membrane following intensive fractional radiation.

The methods of treatment of epithelioma of the skin, esophagus, and tongue are given.

H. C. OCHSNER, M.D.

Effect of Irradiation upon a Malignant Thymic Tumor. Lloyd F. Craver. *Ann. Surg.*, January, 1931, XCIII, 391-397.

A single woman of thirty-nine years, complaining chiefly of cough and dyspnea and presenting on roentgenographic examination a large mediastinal mass believed to be a malignant thymic tumor, probably carcinoma, was treated with enormous doses of roentgen and radium irradiation. Treatment resulted in complete disappearance of all evidence of tumor at the primary site, and at autopsy a large cavity with healed walls was found in the right adrenal gland, and the aortic ab- Various small scattered metastases were found in the bronchial lymph nodes, the left lung, the right adrenal gland, and the aortic abdominal nodes, of which all except the bronchial nodes lay outside of the area that had been irradiated.

F. B. MANDEVILLE, M.D.

ULCER (ETIOLOGY)

Pepper and Gastric Ulcer. Editorial.

Jour. Am. Med. Assn., May 23, 1931, XCVI, 1798, 1799.

Although a century has elapsed since Cruveilhier, in 1829, first clearly described peptic ulcer, it would be rash to venture any conclusions at the present time regarding the precise etiology of this pathologic condition. At present, trauma is not generally believed to play a noteworthy part in the genesis of peptic ulcer, because, it is said, few of the persons who subject their stomachs to mechanical, chemical, or thermic insults suffer from ulcers. Traumatically produced, experimental ulcers heal readily, as a rule.

Bergsma, in Abyssinia, found an exceptionally high incidence of gastric and duodenal ulcer among the black people there in contrast with the comparative immunity of negroes in this country. Their diet included a sauce that was approximately 50 per cent cayenne pepper. From the time native babies are weaned, until old age, the diet contains monotonously the same dishes of sour bread, pepper sauce, mildly intoxicating drinks, beans (occasional), peas, and slightly cooked or raw meat. Disturbances of the stomach are common occurrences, and, at an early age, many individuals suffer from a contracted and scarred pylorus. The opportunity for continued chemical insult to the gastric mucosa seems to be afforded by the unusually high red pepper content of Abyssinian diet. If such peculiarities of dietary regimen are common in other countries, it would be of great interest to ascertain the incidence of gastric ulcer among their inhabitants.

C. G. SUTHERLAND, M.D.

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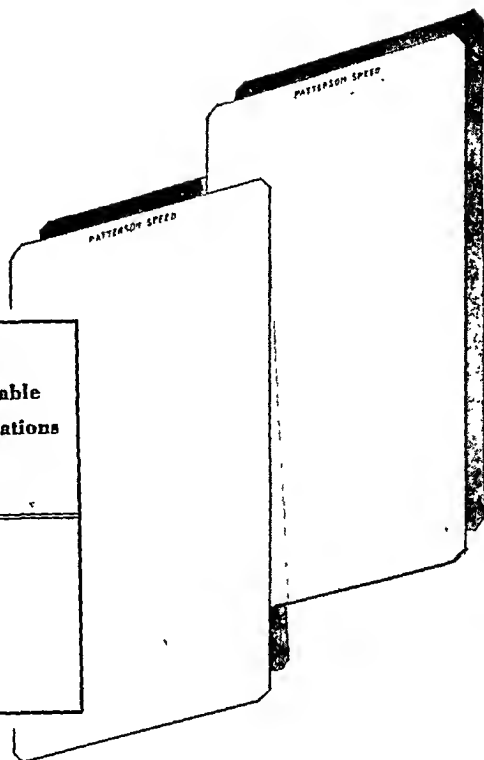
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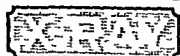
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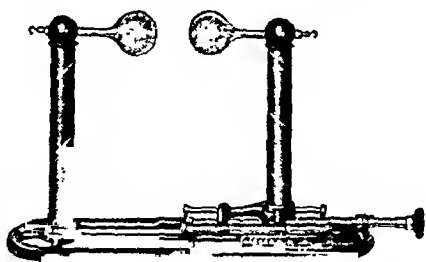
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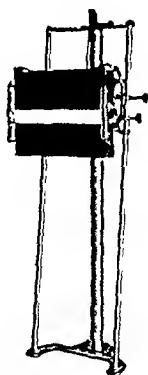
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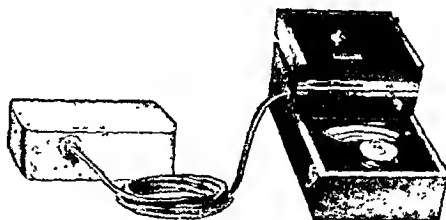
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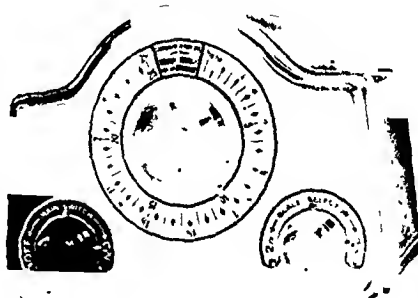
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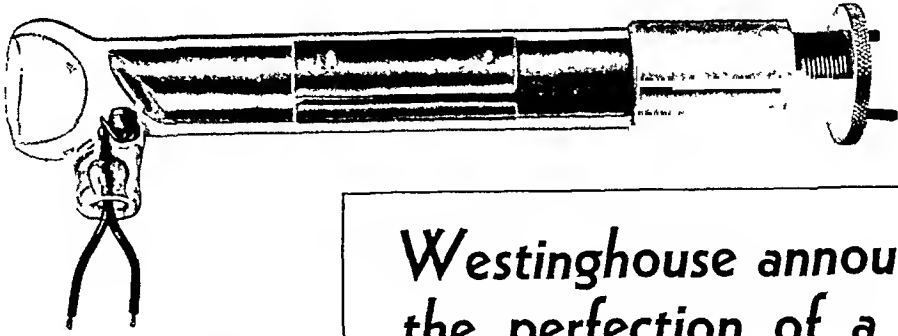
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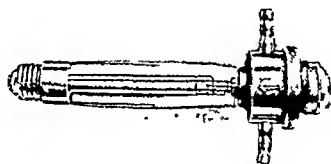
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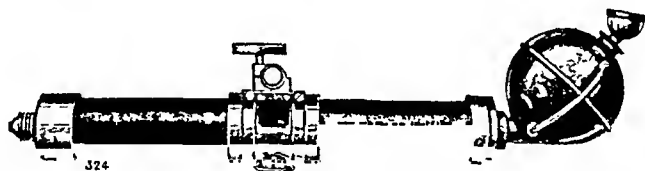
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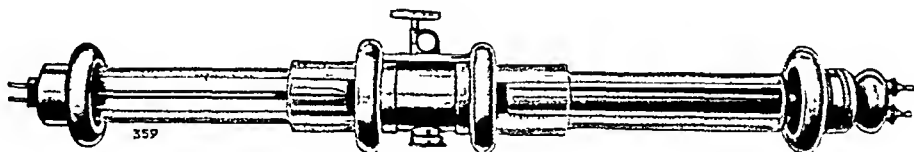


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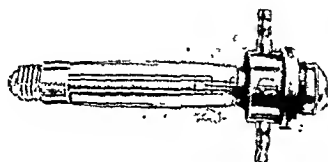
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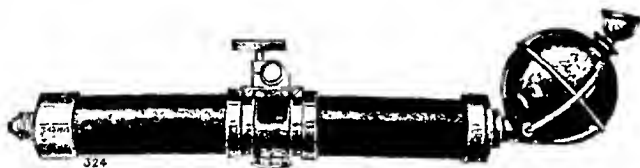
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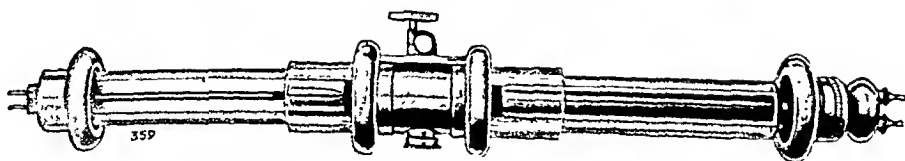


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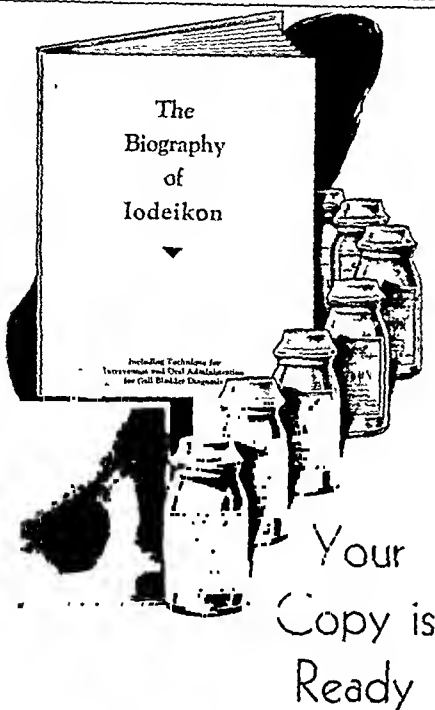
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As its Official Journal



OCTOBER, 1931

Volume XVII

Number 4

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AS pioneers in the development of shock-proof x-ray apparatus, we have been interested observers during the recent Congress of Radiology in Paris. In practically every exhibit by foreign x-ray apparatus manufacturers were seen one or more newly designed apparatus heralded as shock-proof. Everywhere one could overhear discussions among radiologists of the trend toward shock-proof diagnostic x-ray apparatus—nodding their approval of the idea.

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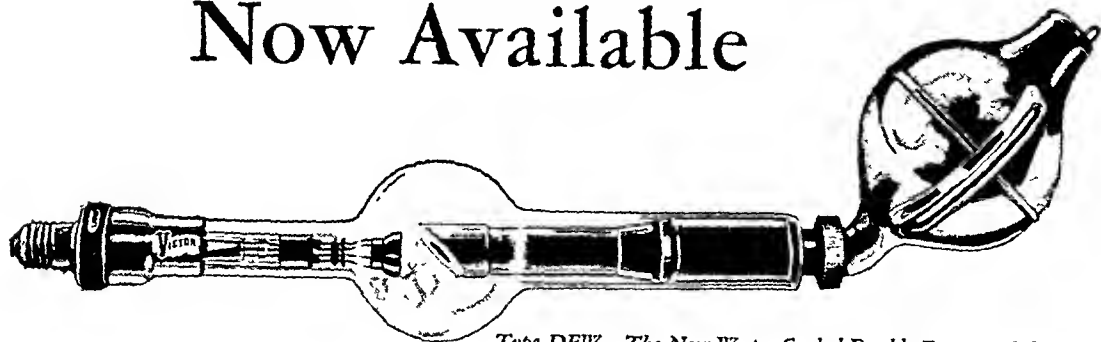
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UNRECOGNIZED VERTEBRAL FRACTURE vs. KUMMELL'S DISEASE (SYNDROME)¹

By FREDERICK W. O'BRIEN, M.D., Professor of Radiology, Tufts College Medical School, Boston

"KUMMELL'S disease," as a diagnosis, is being made by roentgenologists with increasing frequency, much to the consternation of insurers and the confusion of industrial accident boards, often on the unsupported X-ray evidence of a solitary wedge-shaped vertebra and apparently without any clear notion of what Kummell has actually written in so specific a manner about the syndrome he first described.

It was in 1891 that Professor Hermann Kummell, of Hamburg, at the sixty-fourth meeting of the Society of German Biologists and Physicians, at Halle, reported a new symptom-complex which he called "rarefying osteitis of the vertebra." In 1895, in the *Deutsche medizinische Wochenschrift*, No. 11, he made a brief report of this condition, and in 1899 his assistant, Schulz, made an extended one under the title "Traumatic Spondylitis." It was 1921 before Kummell published anything again on the so-called disease which came to bear his name. At this time he reviewed the vicissitudes of his symptom-complex with the caption "Post-traumatic Disease of the Vertebra" (1) and combated the criticisms (annihilating, he called them) of his confrères, protesting that the first description of his symp-

tom-complex still held good and that the cause and the course of the disease were the same as outlined thirty years before.

The cause of the disease is always trauma, Kummell writes, either by direct force against the spinal column or the impaction of a heavy object on the shoulders and neck of the patient. Further results of such an injury are severe pain in the affected portion of the spinal column, of which the patient begins to complain two or three days after the accident. The pain gradually disappears and the patient is able to resume his previous occupation.

After a somewhat longer time, months and often years, severe pains in the spinal column are felt by the patient. Dependent on the position of the injury, there appear also neuralgias in the regions of the various intercostal nerves and slight disturbances of motion in the lower extremities. The gait becomes uncertain, and, if the patient is now examined, one finds, after weeks or months of freedom from symptoms, a definite kyphos and gibbus.

The location of the disease in all Kummell's cases was the thoracic spine, and he notes that the most prominent vertebra, and the adjoining vertebra above and below, were extremely sensitive to pressure, as in the acute stage of tuberculosis of the spine. Also, that when these patients are suspended

¹Read at the Annual Meeting of the Radiological Society of North America, at Los Angeles, Dec. 1-5, 1930.

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healthy man the same as that of a constitutionally weakened individual.

On the basis of his observations, Lange speaks of an osteomalacia traumatica. He explains the traumatic changes in a vertebra and the neck of the femur as due to diminution of the bone caused by the trauma, but without fracture. His interesting experiments prove, says Kummell, that the vertebrae, particularly the lower thoracic and upper lumbar, may be injured by trauma without simultaneous fracture, and that their original shape is recovered, provided the pressure is not too great.

That such processes in the living vertebra are not without consequence is easily understood, Kummell continues, although at first it is not possible to demonstrate the changes by the X-ray. He goes on to say:

It is obvious that a compression of the vertebra such as described above, even though it recovers its former shape, must cause a disorganization of the delicate framework of the bone and produce extravasations of blood in it. A compression fracture or an impacted fracture is, therefore, not necessary to the production of post-traumatic vertebral changes. To effect a gradual disappearance of the bony framework it is sufficient to have a forcible compression of the spongiosa of the vertebra. This is the process as I have first described it and as it doubtless occurs in many cases in addition to those in which definite fracture or fissures of the vertebra are demonstrable.

How there can be disorganization of the delicate framework of the bone and compression of the spongiosa without fracture secondary to external trauma is not clear. What he undoubtedly means is that there is no immediately demonstrable fracture such as one would readily diagnose clinically from compression cord symptoms or by the X-ray. By definition, a fracture is the breaking, either partial or complete, of a solid body by force.

Kummell's disease, so called, is always ac-

companied by a wedge-shaped vertebral body, so that ultimately there is always a shortening of the vertebra, proving, by Lange's own experiments, that pressure on the vertebra must have exceeded the limit so that irreversible shortening has occurred.

It is conceivable that on the first X-ray examination fracture of a vertebral body may not be determined, as may be the case in fracture of the neck of the femur. Even to-day, with the very best X-ray technic, a fracture of the femoral neck may not be immediately demonstrable, one's suspicion being confirmed when, later, absorption of the neck has taken place. Unless the network of the spongiosa has been broken by injury or disease there is no reason to assume that a vertebra will collapse.

The sharply defined symptom-complex of post-traumatic vertebral disease (Kummell's disease), he writes in résumé, comprises three stages:

1. Trauma is a necessary preliminary to the disease, either direct or indirect, by pressure on neck and shoulders or wrenching and crushing of the vertebra such as might be due to the patient jumping from a vehicle. Very often the injury is produced by sitting down with great force and the patient soon forgets the actual injury. The stage of more or less severe shock which follows the injury very quickly disappears in the usual course of events. Local pain in the spine and temporary signs of involvement of the cord are sometimes present.

2. The stage of relative well-being and resumption of the patient's occupation depends, like the duration of the first stage, more or less upon the nature and kind of the injury. Some patients are never wholly free from pain but after the first few days they usually manage to resume their normal occupation, although in a limited way. Others, however, after a few days of discomfort, resume their occupation, often with difficulty and laboriously. Differences in the nature

from the head the kyphos usually disappears although the gibbus remains. Since a deep-seated destruction of one or more of the vertebræ has occurred the deformity can no longer be straightened by treatment.

Briefly, he says, we have here a trauma, often insignificant, which affects the spinal column either directly or indirectly, and its immediate manifestation disappears after a few days, only to reappear after months of well-being in the form of a rarefying process of the vertebræ, accompanied by atrophy. In this disease suppuration never occurs, as in the case of tuberculous spondylitis, nor is hypertrophy of the bony mass observed, as in the case of the syphilitic process or newgrowths, and other changes, as in arthritis deformans.

Kummell changed the name of the disease several times because of the doubtful etiology of the condition. The first name chosen by him, "rarefying osteitis of the vertebra," was justified, he believed, because it emphasized the disappearance of the vertebral spongiosa, which takes place gradually after the trauma. The name proposed by Schulz, "traumatic spondylitis," was probably not justified, since the process is not inflammatory but merely traumatic. "Post-traumatic disease of the vertebra" he thought more appropriate, since that is not based on any disputed pathologic process but on the unquestioned cause of the disease—trauma—without which the condition never occurs.

He says:

A fracture or cracking of the vertebra due to trauma can be ruled out, as in the first place the injuring force was in most cases too weak to bring about such a result, and in the second place the temporary pain does not permit the assumption of so severe an injury as fracture of one or more vertebræ. It must, therefore, be assumed that the vertebræ which were affected by the relatively light blow or compression were so disturbed in their nutrition that

an atrophy of adjoining vertebral surfaces resulted, which steadily progressed from the time of injury until the instigation of treatment. This is, therefore, a purely local condition that has nothing in common with a constitutional disease or a neuropathic infection.

Kummell goes to great length to prove that post-traumatic disease of the vertebræ is not a compression fracture, yet in controverting Wullstein, who attacked the disease as a separate entity, Kummell concedes that it occurs as a result of impacted compression fracture but asserts that it also occurs as a result of traumatic influences which cannot often be demonstrated.

He calls to his aid the experimental observations of Lange, of Copenhagen, who took ten thoracic vertebræ from recent autopsies and subjected them to a pressure in a machine such as is used by engineers to test the strength of materials. His results were as follows, quoted by Kummell:

Each vertebra breaks with a certain pressure, but before the break occurs definite changes take place.

Pressure on the vertebra shows no demonstrable changes as long as a certain limit is not exceeded.

If this limit is exceeded, a shortening of each vertebra occurs; the vertebræ are measurably compressed.

If the pressure does not exceed the limit, the shortening disappears after the relapse.

If the pressure exceeds the limit, the deformity does not completely disappear. The compressed vertebræ recover somewhat but never reach their former height.

Besides the amount of pressure, the length of time plays an important part in this permanent shortening. The same pressure which, after short action, is followed by complete restoration, produces an irreversible shortening if the action is prolonged. In this report, the vertebra of the adult acts the same as that of a child; the vertebra of a

vertebra by jumping (as from a moving vehicle). It certainly is not meticulous to ask if this description of Kummell's disease does not correspond to the classical description of what is necessary for fracture of the spine, namely, direct or indirect force applied to the spine in hyperflexion or hyperextension or when the longitudinal axis is shortened.

Yet very recently Blaine (3) has written:

The principal feature in the discovery of a case of spondylitis traumatica tarda is the finding roentgenologically of a more or less collapsed vertebral body, often without kyphos or knuckle. It may be incident to an examination for non-traumatic lesions.

Such a finding—"without kyphos or knuckle"—should make one feel rather certain that one is not dealing with Kummell's disease. Blaine continues:

A striking feature of post-traumatic spondylitis tarda is the surprisingly small degree of disability that results in most cases. In fact, if true disability were to occur, I would question whether it were a case of Kummell's disease.

This might be paraphrased thus: A striking feature of fracture of a vertebra without cord involvement is the surprisingly small degree of disability which results in most cases. In fact, if true disability were to occur, I would question whether it were a case of fracture without cord involvement.

Kummell has plainly written that the disability depends upon the nature and kind of injury.

Most writers have grouped recognized vertebral fracture, with or without delayed symptoms, with a description of Kummell's disease.

Fosdick Jones (2), in 1923, reviewed some 106 cases in the literature, including one of his own, under the title "Compres-

sion Fracture of the Spine Developing Delayed Symptoms (Post-traumatic Spondylitis, or Kummell's Disease)." He did not mention a paper by Wallace, of Pittsburgh. As far as I am able to learn it is the largest single contribution of anyone in the literature. Wallace (4) described in detail 82 personal cases of fracture of the spine, some 47 of which were not diagnosed until the appearance of delayed symptoms.

Of the 82 cases of fracture of the spine recorded by Wallace, in 67 a definite history of forcible flexion of the spine was given: 20 cases were promptly recognized, 75 per cent of which showed paralysis; 47 cases were undiagnosed; three cases (6 per cent) had paralysis in some degree. The shortest elapsed time of the undiagnosed cases was 25 days, the longest 1,045 days, the average 311 days. A single body was crushed in 60 cases, more than one in 21 cases; the first lumbar, in 33 cases (or 41 per cent), and the second lumbar in 19 cases (or 23 per cent). The ages ranged from 16 to 65 years, the average being 39. Nearly all of the patients were coal miners.

Kummell recognized that compression of a vertebra may result from indirect as well as direct injury. Yet it is evident that the character of the force is only part of the picture: the character of the body receiving the applied force and its relationship anatomically and physiologically at the time of the trauma come to the foreground.

Stern (5) declares the cause of spinal fracture is to be found sometimes in unusual muscle effort, that the most frequent cause of vertebral fracture is indirect violence which gives rise to a hyperflexion or hyperextension of the trunk or to a shortening of the longitudinal axis of the column beyond the limits of its elasticity. When these factors are combined with lateral bending, more or less rotation or tilting of the body of the injured vertebra takes place.

Those of us who have had the experience

of the trauma, the extent of the injury, and the resistance of the individual, of course, prevent any hard and fast rules being laid down for this period of well-being.

3. The stage of gibbus formation and the return of local pain in the injured vertebra, the last one which presents a complete picture of post-traumatic vertebral disease, is easily diagnosed clinically as well as by the X-ray.

It is erroneous, Kummell says, to look upon rarefying osteitis as an independent symptom-complex, just as it is erroneous to look upon the compression fracture as a single cause, even in those cases in which the X-ray shows such a process to be present beyond question. The various gradations of the effect of the trauma must be considered as constituting the etiologic factor. Here it would appear Kummell is talking about cause and effect, confusing proximate and approximate, mediate and immediate, in an endeavor to make the etiologic factor something unique.

The pathologic-anatomical support which Kummell adduces is not convincing. He refers to an autopsy specimen described by Ludloff in which the last two lumbar vertebrae were studded with small hematomas, although no fracture was present. The pathologist Ponfick remarked, "This is a case which *almost certainly would have led to a so-called 'Kummell's kyphosis.'*"

A pathologic report by Hatterer in Gärre's clinic is next made use of. A patient, aged 61 years, had fallen on the ice a few years before and almost two years later had had another accident. Pain and disability increased until she was unable to move her extremities. The hospital record reports a definite gibbus of the ninth and tenth thoracic vertebrae, the pathologic diagnosis being "rarefactio vertebarum dosarum et lumbarium. No compression of the vertebrae is observed."

Kummell then proceeds to quote Hatterer's description of what is necessary for the repair of fracture of the vertebra, and why osteitis traumatica occurs in untreated fracture, which is beside the point if Kummell's disease is not fracture.

A case reported by Wiegel is then in order. A man aged 41 years lifted a heavy box and complained of severe pain in the lower portion of the spinal column. He died six months later of an intercurrent disease. On autopsy, a cavity the size of a hazel nut was found in the first lumbar vertebra in which the spongiosa was replaced by a jelly-like substance. "It appears that the patient died," Kummell adds naively, "before a further degeneration of the spongiosa and the formation of a gibbus could take place."

The last pathologic specimen Kummell utilizes is one demonstrated by Rumpel, in 1898, in which the first lumbar vertebra was wedge-shaped and united to the adjoining vertebra by a bony mass, which he said was the result of compression fracture without dislocation.

Of the four autopsy specimens, one was frankly a compression fracture and three might have been any one of several other things.

Pbalthzard, in 1914, in what has been described by Jones (2) as the first complete report of postmortem findings recorded in surgical annals on Kummell's disease, reported a case which resulted in the death of the patient six months after the accident. The necropsy findings showed a marked spinal scoliosis, with a compression fracture of the anterior portion of the body of the eleventh dorsal vertebra. Nevertheless, Jones adds, the exact pathogenesis of this disease is still theoretical.

Kummell said his disease always followed trauma, either by direct force against the spinal column or the impaction of a heavy object on the shoulders and neck of the individual, or by his sitting down with great force or wrenching and crushing the

Kummell said his disease always followed trauma, either by direct force against the spinal column or the impaction of a heavy object on the shoulders and neck of the individual, or by his sitting down with great force or wrenching and crushing the

especially where no paralysis is present, these complicating injuries are so apparent that no thought of the possibility of a vertebral fracture enters the examiner's mind at first. If, later, the patient complains of backache his complaints are not sufficiently heeded to cause the physician to examine the back, and the patient is appeased by being told that he "ought to expect a backache after the jolt he got."

A knowledge of the roentgen appearance of the normal vertebra and its physiological cycle of change, as well as the anomalies of birth, is of first importance before one begins to consider the pathologic—a platitude, if you like, but one that needs restatement constantly.

Froelich, of Nancy, in 1920, quoted by Sinding-Larsen (9), described a number of cases of alleged traumatic spondylitis, the radiographs of which (both front and side views in two cases) show the presence of horizontal fissures through the middle of several bodies, with or without deformation of the latter (Fig. 1). According to Froelich, the fissures were due to numerous trabecular fractures.

Hahn (10), in 1922, was the first to recognize the blood vessel origin of the slit-like appearance, often observed on the lateral roentgenogram of the spine of a young individual (Fig. 2). He believed this slit-like appearance represented the X-ray projection of nutrient foramina and was to be observed only during a short period of adolescence, when an increased blood supply was present.

Hanson (11), of Stockholm, has made a detailed study of this problem based on 360 pathologic cases, 40 so-called normal individuals (ranging in age from 6 months to 19 years), and 8 full-term fetuses. He studied the course of the vertebral arteries by injecting Teischmann's substance into the carotid or the aorta of fetal bodies of different ages. By this method he succeeded in demonstrating arteries, even of very fine caliber,

on roentgenograms (Fig. 3), as well as on anatomical preparations. A study of these preparations shows, he says, that the arteries are not concerned with the peculiar vertebral formations described above, their arrangement having been found to be as follows: A small artery, a direct branch of the aorta, passes backwards along each side

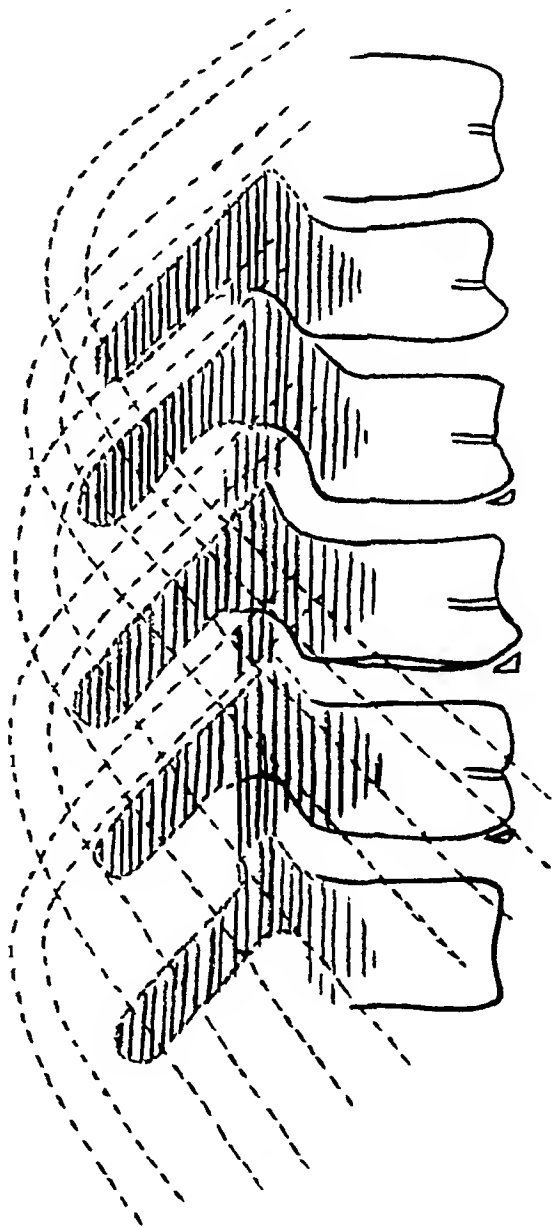
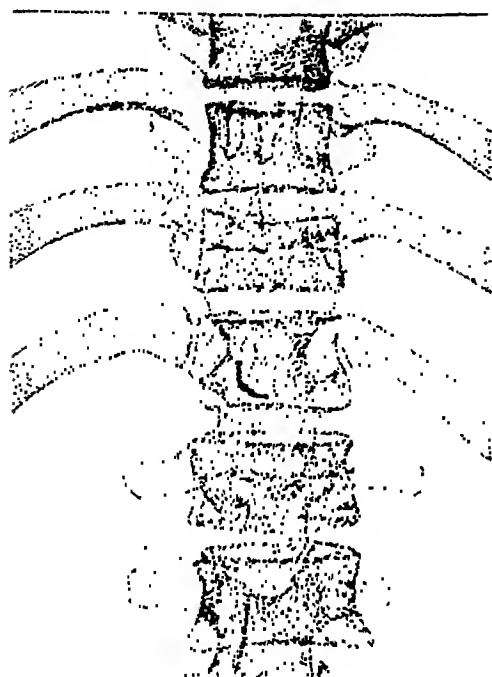


Fig. 2. The slit-like appearance, often observed on the lateral roentgenogram of the spine of a young individual. (After Hahn.)

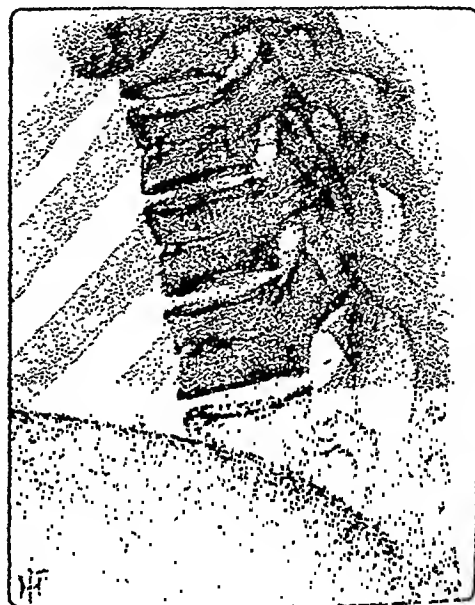
of a busy casualty clinic realize how relatively mild trauma, usually indirect, may cause fracture of a vertebra. Cardis, Walker, and Olver (6) report an impressive case of a man, aged 28 years, who, while riding

reached and the bony segments have been crushed by the force. Such fractures usually occur where the spine is least flexible, as in the dorsal region.

Fractures from the compression of hyper-



a



b

Fig. 1. Showing alleged traumatic spondylitis, with horizontal fissures through the middle of several bodies. (From Froelich's "Chirurgie Reparatrice et Orthopedique," after Sinding-Larsen.)

a motorcycle, was struck on the left foot by a car which unexpectedly emerged from a side street on his left. Only the patient's foot was struck; his back was not directly injured and he was not unseated. He was certainly jarred severely but he resumed a twelve-mile journey on his motorcycle. One week after the accident the patient noticed a lump in the small of the back, with associated pain and tenderness. A roentgenogram showed a wedge-shaped collapse of the second lumbar body.

In shortening of the longitudinal axis of the vertebral column, fracture results because the limit of compression has been

flexion or hyperextension are most commonly found in regions where flexible segments join the more rigid portions, as in the dorsal lumbar, dorsal cervical, and cervical occipital regions.

Sever's (7) cases of compression fracture of the vertebrae followed severe violence, usually a crushing force applied through the long axis of the spine or while the spine was flexed. All were diagnosed late. One reason for late diagnosis, given by Hartwell (8), is that the force which causes vertebral fracture is so great that in at least a third of the cases other severe injuries accompany the spinal fracture, and in many instances,

middle line towards the foramen vertebrale. The excavation disappears during the second year of life except in the lower fifth, sixth, and seventh dorsal vertebræ, and in the first

view for a fracture line, and it warns against interpreting anomalies of epiphyseal development as compression fractures or disease because they happen to be wedge-shaped.

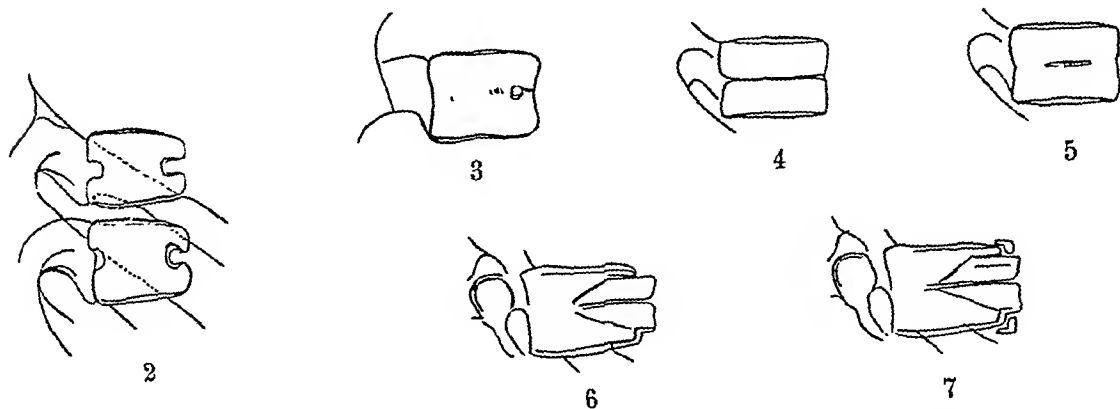


Fig. 4. Showing venous channel and types of vertebral bodies. (After Hanson.)

and second lumbar, where it remains till the age of 14. The canal formations can appear in different forms during the period from two to 14 years, as is shown in Figure 4 (drawings 2, 3, 4, and 5).

In some individuals the vertebral body has a staircase-like outline at its two anterior corners, as shown in the drawing numbered 6. The epiphyses are formed in these staircase-like formations, as shown in the drawing numbered 7. The author (Hanson) has found vertebræ of this kind in individuals with rounded backs, and is assuming that this peculiar shape of the vertebræ may be the anatomical foundation of some cases of kyphosis. He found epiphyses in a child aged 6, though they have previously been stated not to occur before the age of 11. He found the described canal formations in all cases examined—in fetuses 35 centimeters in length and in individuals up to the age of 14. This work of Hanson's, it seems to me, is of outstanding value, since it rules out at once several possible sources of error in the interpretation of roentgenograms of the spine. There is no longer any excuse for mistaking the venous blood vessel as seen in the lateral

If the wedge-shaped vertebra is the result of fracture, it may be asked, why not callus formation, and a return to normal?

The progress of any given case of fracture of the spine is necessarily very slow, as the formation of true callus in the vertebral osseous tissue is very slight in comparison with that formed in the long bone. True union often does not take place, a condition which is most frequently seen in compression fracture of the bodies. Absorption and rarefaction of the bone often takes place. After the erect posture is assumed, a kyphosis slowly develops over the seat of fracture and the injured segment sags forward.

Kolodny (12) has shown that an adequate blood supply to the periosteum is essential for normal union of fractures, and that periosteal callus plays a far more important rôle in the union of fractures than endosteal callus.

Hanson's work, already referred to, has demonstrated the poverty of blood supply to the vertebræ, thus rendering conditions ideal for non-union and consequent collapse of the vertebral bodies. If the injury to the spine has been slight and immobilization and hy-

and close to the middle of the vertebral body, to which, having reached its dorsal aspect, it gives off small branches. Passing appears on a lateral roentgenogram as divided into three plates, one upper and one lower of denser nature, and one—lighter—



Fig 3 Showing arterial supply to vertebra (After Hanson)

through the intervertebral foramen, small branches are supplied to the arch, while the main branch continues to the posterior aspect of the vertebral body, piercing this near the middle line.

Hanson observed that from late fetal life until the age of two years the vertebral body

between these. In the anterior margin of the latter there is seen to be an excavation in the shape of an amputated cone with its base directed forwards. This excavation is occupied by a vein, running close under the perichondrium and periosteum, respectively, and continuing by a stem on each side of the



Fig. 7. The patient was a male aged 60, who was struck on the back by a stable door, with no apparent injury. First X-ray examination (Feb. 14, 1924) showed no definite evidence of fracture.



Fig. 8 Same case as shown in Figure 7. Re-examination (March 11, 1924) showed definite X-ray evidence of fractures of the first, third, and fourth lumbar vertebrae.

logic conditions are of the age period of childhood and adolescence their scars are carried over into later life and may well be a source of confusion.

The flattening and wedging may well be the result of minute fractures, if one accepts their origin to be the result of imbalance between the static demand and static capacity.

Calvé, in considering the etiology of osteochondritis and epiphysitis, eliminates tuberculosis, syphilis, Kummell's disease, and congenital malformation. He believes that an infectious origin is the most probable of all etiologic factors. Buchman considers lightly the history of injury usually elicited in these cases, but if the process is an infectious one, with physiologic starvation, injury might well be considered the approximate cause of the vertebral collapse as well as the static imbalance.

Osteo-arthritis of the proliferative type, with wedge-shaped vertebrae and deformi-

ties, mechanically, at least (disregarding its infectious or non-infectious origin), may well represent minute compression fractures consequent to repeated small traumas, impoverishment of blood supply, and bad posture from faulty habits or the demands of certain occupations (Fig. 7).

If one presupposes disease prior to the collapse of a vertebra, as bone cyst or primary or secondary malignancy, the fact still remains that one is dealing with fracture.

I have just seen the X-ray films of a case of Hodgkin's disease primary in the spine, with characteristic wedge-shaped vertebra and kyphos, undiagnosed until general glandular enlargement appeared after two years. If it is any or all of these conditions, it is no longer the specific entity of Kummell's disease.

Kummell plainly states that the largest part of his observations and communications was made at a time when Roentgen's dis-



Fig. 5. Wedge-shaped vertebra as commonly seen in dorsal group (physiological).



Fig. 6. Wedge-shaped vertebra of epiphysitis involving fourth, sixth, and ninth dorsal vertebrae.

perextension employed promptly, a relative return to normal may be expected to occur. Although some degree of compression may remain, there will not be collapse.

If, in addition to the lesions demonstrable by the X-ray, there are present (as Reuter, working in Kalisko's Medical Legal Institute, in Vienna, showed) numerous smaller ones distributed over a wide area, such as fissures of the discs, lacerations of the ligaments, etc., these may later give rise to a condition of chronic ankylosis of the spine.

If Kummell's disease is not fracture, what may it be? Not tuberculous spondylitis; not arthritis deformans; not syphilis, according to Kummell.

It is perfectly evident that every wedge-shaped vertebra, with or without kyphos, is not the result of fracture. If one encounters a wedge-shaped vertebra without a history of trauma or definite evidence pointing to fracture or disease, it will be necessary to

examine the entire spine, for, as Bowman and Goin (13) have pointed out, an extra half vertebra occurs, wedge-shaped in appearance, which is truly an extra segment and is sometimes thought to be a compression fracture.

Then there is the wedge-shaped vertebra so commonly seen in the dorsal group, the result of physiologic change (postural) (Fig. 5), or the erratic development of a congenital anomaly or an osteochondritis or an epiphysitis. The affected vertebra in osteochondritis and epiphysitis (parallel conditions going on at different periods of growth, according to Buchman, 14) may be oblong (a parallelogram) or wedge-shaped, with the base of the wedge anteriorly or posteriorly placed (Fig. 6).

Furthermore, very definite repair processes are evident, which leave the vertebral outlines dense and sclerosed. Multiple vertebrae are often affected. While these patho-

series of traumatic spines seen at the Cambridge City Hospital with Dr. Benjamin Godvin and followed roentgenographically over a period of years, what Kummell has described is unrecognized, hence untreated, fracture of the spine—unrecognized because of no cord symptoms, inadequate or no roentgen examination, and the erroneous belief that if one can walk and has suffered only a slight (mild) trauma one cannot have a fracture of the spine.

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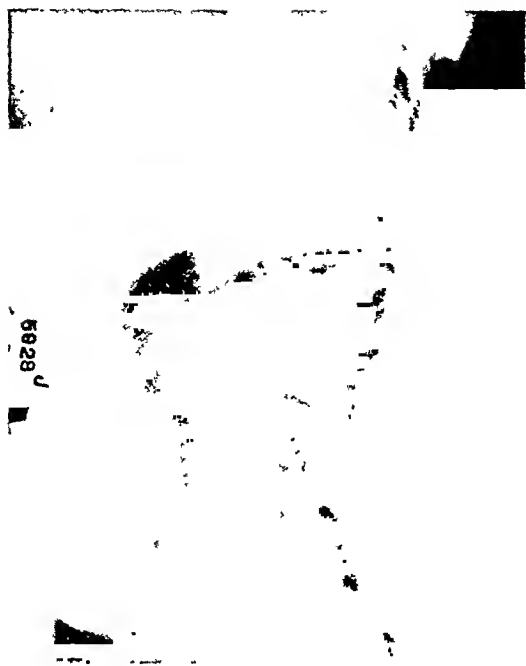


Fig 9. Showing the end-result (Feb 15, 1928) in same case shown in Figures 7 and 8

covery was as yet unknown, or at least not practically available. He says:

Even to-day [writing in 1921] the number of X-rays which could give help in clearing up causation of the disease is not great. This lies in the nature of the disease, since a patient only rarely has an X-ray taken, shortly after the accident, as the first painful stage is quickly over and a feeling of improvement and relief obtained. No X-ray can be found in the literature which was taken shortly after the trauma and which might be compared with a later picture.

This statement of Kummell's no longer stands. Satisfactory X-ray negatives of the spinal column in the anteroposterior projection as well as lateral have been a development of the last few years. Even in the fifth edition of Köhler's (15) excellent monograph, translated in 1928, speaking of the lumbar vertebræ, one reads:

These are usually viewed in dorsal negatives;

occasionally, too, an oblique negative is helpful, and in children, even a profile negative. Even in the adult, satisfactory profile negatives can often be secured.

With our present X-ray equipment and technical methods one must do a great deal of explaining if he fails to produce satisfactory negatives of the spine in any projection. Improved roentgen technic and diagnosis are the explanation of the infrequency with which one now encounters Kummell's syndrome. Early in the course of the patient's complaint, if not at the time of injury, adequate X-ray studies are now made, which usually reveal the extent of the trauma, and a diagnosis of compression fracture can be promptly made. Appropriate orthopedic treatment, such as hyperextension, instituted early, will prevent complete collapse of the vertebral body in some cases and definitely forestall gibbus formation.

A so-called negative X-ray report should not be accepted wholeheartedly. The term "negative" should be dropped from the nomenclature of the roentgenologist. Figure 8 is a photographic reproduction of a lateral roentgenogram of the lumbar spine of a man, aged 60, who was struck in the back when a barn door came off its hinges. Because of "cupping," seen in the superior articular surface of the third lumbar vertebra, and my particular interest in Kummell's syndrome, this case was followed carefully, and, much to my surprise, on re-examination in less than three weeks the first lumbar vertebra was found to be wedge-shaped, the superior articular surfaces of the third and fourth lumbar vertebræ compressed and pitched forward (Fig. 9). Now, four years later, because of early adequate orthopedic treatment, there is no kyphos or gibbus (Fig. 10). This is the only case I have seen which approximates Kummell's description of the early stage of post-traumatic disease of the vertebra, and yet it was fracture.

In my opinion, based on a rather unusual



Fig. 1. Position of the patient on the roentgenographic table in making cholecystograms. The patient is comfortable, relaxed, his head is turned to the right side and his toes are over the end of the table. No discomfort from pressure points.

pleted. This makes a coffee-and-cream-colored mixture with an agreeable taste.

In either case the dye is fresh and there is no risk in the administration. We know that it takes the gall bladder at least an hour to empty after a meal, and the dye should be given one or two hours after the regular evening meal so that the gall bladder is receptive to the opaque bile.

(C) *Twelve-hour Examination.*—Twelve hours after the administration of the dye, every effort is made to demonstrate a shadow of the gall bladder. The 16-hour examination is carried out regardless of the 12-hour findings, and the patient is cautioned *not to eat or drink anything but sips of water* in the interim. He is instructed to *take*

an enema just before returning for the 16-hour examination to clear out the colon contents so that gas and visible particles of the dye will not obscure the gall-bladder shadow. It is an advantage to see the dye in the 12-hour films so that one may be sure it has been taken and not lost by vomiting or diarrhea.

(D) *Further Examinations.*—At the 16-hour examination, if any shadow of the gall bladder can be distinguished, the patient is asked to return for examination *immediately* after eating a meal. Depending on the degree of contraction of the gall bladder at this examination (17-hour), another examination is usually made an hour later (18-hour) to demonstrate maximum con-

ORAL CHOLECYSTOGRAPHY OF TO-DAY¹

By WILLIAM H. STEWART, M.D., and H. EARL ILLICK, M.D., NEW YORK CITY

INTERPRETATION of cholecystographic findings is entirely dependent on the technic of conducting the examination and there still exists a lamentable lack of standardization or uniformity in this technical procedure and conduct of the examination. We do not mean to imply that there is only one correct way in which to make the examination, but there are certain all-important fundamentals which must be acknowledged in the management, especially of the "faint" and "no shadow" cases. Our experience has been that the majority of films (75 per cent) submitted here for examination from other laboratories where a cholecystographic examination has been performed and a diagnosis made, are of inferior quality, usually almost black, on which a report of "no shadow" and pathologic gall bladder has been made. The impression is prevalent that a Graham test is a Graham test however performed, and that if a few films result in no gall-bladder outline being discernible, then the gall bladder must consequently be diseased. One of these most important fundamentals is that every "faint" and "no shadow" finding *must be confirmed* by a repeat examination. We have no quarrel with advocates of the intravenous method, as we are confident that the route of administration is only a minor matter and that, *properly* performed, the test will be equally dependable. We do question if the intravenous method is infallible and believe that a "faint" or "no shadow" finding should be confirmed, regardless of the route of administration. Success in cholecystography is in direct proportion to the technical quality of the films; the best interpreter will not be able to diagnose pathologic involvement from mediocre films.

The *method of procedure* which we have found to be most satisfactory in obtaining reliable findings in cholecystography is as follows:

(A) *Preliminary.*—The patient makes an appointment for the examination, at which time a thorough cleaning out is ordered. After this, the preliminary films are made which localize the lower border of the right lobe of the liver and this correct position is marked on the skin of the patient's back. The best exposure technic for this patient is also recorded, so that results may be duplicated. Usually the tube is accurately centered over the right twelfth rib posteriorly, slightly above in obese patients, and sometimes considerably below in thin patients (Fig. 1). If calcified stones are found on these preliminary films, the Graham test adds very little positive information unless differentiation from renal calculi is necessary.

(B) *Details of Oral Administration of the Dyc.*—What is the best oral method to use? The two methods which we have found to be most trustworthy are the gelatine capsule in divided doses and the one-dose administration in sarsaparilla. In the capsule method for the average 150-pound patient, eight plain gelatine capsules are loosely filled with the contents of the 3.5 gram ampoule. Two capsules with 5 grains of bicarbonate are given every 15 minutes until all are taken, beginning at 8 P.M. This method is ideal for the private patient and consistently reliable results are obtained. In hospital use the contents of the ampoule may be dissolved in one ounce of water which, in turn, is mixed with a half-glass of sarsaparilla which has been thoroughly stirred until effervescence has been com-

¹Read in abstract before the Third International Congress of Radiology, Paris, July 26-31, 1931.

cases or others who are unable to suspend respiration for a reasonable length of time, and in such cases the quality is sacrificed.

The kilovoltage must be the lowest possible in proportion to the thickness of the body. In a patient whose body is eight inches thick, about 65 K.V. should be used; ten inches, 75 K.V.; twelve inches, 85 kilovolts. This is one of the most important of the technical factors, and in no other way can maximum contrast be obtained and the films have the necessary "snap" and wealth of soft tissue detail.

A film size of 8×10 is the most acceptable, as the area covered is large enough to include the entire right side at the level of the twelfth rib. An excellent gall-bladder outline on an 8×10 film may be easily overlooked on a 14×17 size film. Secondary rays are minimized by using a cone just large enough to cut the corners on an 8×10 film at 25 inches tube-film distance. A 10×12 film is sometimes used to localize the gall bladder.

A Bucky diaphragm is an aid in obtaining maximum contrast. The curved Bucky has given us the best results.

Compression by means of a rubber bladder is a very important means of obtaining the best films. The bladder must be squeezed down as firmly as the patient will permit, thus making the body as thin as possible and also aiding the patient to completely suspend respiration.

In the matter of the patient holding his breath, he must be at rest with feet over the end of the table or legs supported and no unpleasant pressure spots; he must be educated carefully and watched on several trials to insure perfect relaxation and proper suspension of respiration (Fig. 1). It is helpful to have the patient hold his nose closed with his fingers. More films are wasted in obtaining co-operation from the patient in this detail than in any other way. The least motion during exposure will result in fuzziness



Fig. 2-C. Another example of normal, extreme contraction of the gall bladder after a meal. The ducts as well as the spiral valves of Heister are visible.

and lack of detail and generally poor films. In such, small negative calculi are overlooked and also the faintly outlined gallstones with thin calcified rings. Time and again such shadows are visible on only one or two films of the whole series, because those were of the best technical quality and there had been no motion from breathing (Fig. 3).

STANDARD BY WHICH TO JUDGE WHAT CONSTITUTES A SATISFACTORY CHOLECYSTOGRAPHIC EXAMINATION

(1) In normal cases, preliminary films before the dye is given reveal no gall-bladder shadow; after the tetraiodophenolphthalein the gall-bladder outline becomes more intense from the twelfth to the sixteenth hour; is of normal size, shape, and position and contracts down *markedly* after



Fig 2-A. An average normal shadow of the gall bladder at the 16-hour examination.



Fig 2-B. Normal, extreme contractility after a meal, a finding which rules out pathologic involvement. Note the elevation of the gall bladder after a meal.

tractility (Figs. 2-A and 2-B). If the gall bladder empties slowly, a 19-hour examination is made. The final examination is made at 36 hours, early the following morning, and barium is then given to outline the stomach and duodenal cap.

(E) The stomach and duodenal cap are routinely examined after a barium meal following every Graham series, because in a surprisingly large proportion of cases with negative cholecystographic findings, gastric or duodenal ulcer (Fig 12) or malignancy is found. A few times both a pathologic gall bladder and a gastro-intestinal lesion have been found in the same patient. It is sometimes an advantage to fill the duodenal cap with barium while the gall bladder is distended with opaque bile, as occasionally by this method pericholecystitis and periduodenitis may be diagnosed, although we are

opposed to this as a routine procedure. In thin patients with fairly intense gall-bladder shadows, fluoroscopy may be of value in permitting direct palpation of the gall bladder for localization of tenderness or detection of fixation. In stout individuals or instances of faint shadows, the gall bladder is too indefinite to be recognized with certainty.

(F) *Details of Radiographic Technic that Insure Successful Examinations.*—A tube of 30 ma. has been found most satisfactory for general use, as detail is almost as good as with 10 and much better than with 100 milliamperes. Ten milliamperes may be used in thin patients who co-operate well in holding the breath, especially since faster films and screens are available. One hundred milliamperes are frequently necessary in muscular or obese subjects and cardiac

cases or others who are unable to suspend respiration for a reasonable length of time, and in such cases the quality is sacrificed.

The kilovoltage must be the lowest possible in proportion to the thickness of the body. In a patient whose body is eight inches thick, about 65 K.V. should be used; ten inches, 75 K.V.; twelve inches, 85 kilovolts. This is one of the most important of the technical factors, and in no other way can maximum contrast be obtained and the films have the necessary "snap" and wealth of soft tissue detail.

A film size of 8×10 is the most acceptable, as the area covered is large enough to include the entire right side at the level of the twelfth rib. An excellent gall-bladder outline on an 8×10 film may be easily overlooked on a 14×17 size film. Secondary rays are minimized by using a cone just large enough to cut the corners on an 8×10 film at 25 inches tube-film distance. A 10×12 film is sometimes used to localize the gall bladder.

A Bucky diaphragm is an aid in obtaining maximum contrast. The curved Bucky has given us the best results.

Compression by means of a rubber bladder is a very important means of obtaining the best films. The bladder must be squeezed down as firmly as the patient will permit, thus making the body as thin as possible and also aiding the patient to completely suspend respiration.

In the matter of the patient holding his breath, he must be at rest with feet over the end of the table or legs supported and no unpleasant pressure spots; he must be educated carefully and watched on several trials to insure perfect relaxation and proper suspension of respiration (Fig. 1). It is helpful to have the patient hold his nose closed with his fingers. More films are wasted in obtaining co-operation from the patient in this detail than in any other way. The least motion during exposure will result in fuzziness



Fig. 2-C. Another example of normal, extreme contraction of the gall bladder after a meal. The ducts as well as the spiral valves of Heister are visible.

and lack of detail and generally poor films. In such, small negative calculi are overlooked and also the faintly outlined gallstones with thin calcified rings. Time and again such shadows are visible on only one or two films of the whole series, because those were of the best technical quality and there had been no motion from breathing (Fig. 3).

STANDARD BY WHICH TO JUDGE WHAT CONSTITUTES A SATISFACTORY CHOLECYSTOGRAPHIC EXAMINATION

(1) In normal cases, preliminary films before the dye is given reveal no gall-bladder shadow; after the tetraiodophenolphthalein the gall-bladder outline becomes more intense from the twelfth to the sixteenth hour; is of normal size, shape, and position and contracts down *markedly* after

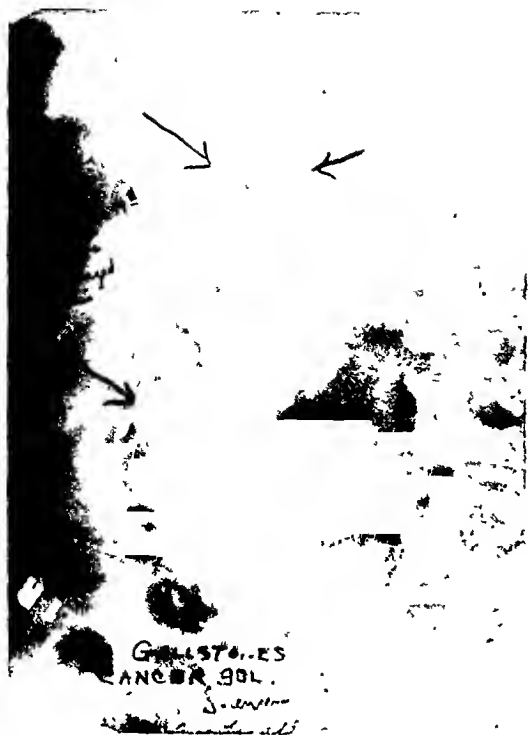


Fig. 3. Faintly outlined, thinly calcified, ring-like gallstones, visible on only a few of the best roentgenograms in a series, and which would be missed on any except those of the highest quality. This patient, aged 52 years, complained for two weeks of pain in the gall-bladder region. A tumor was palpable. X-ray examination showed large gallstones and a large gall bladder.

Operation—Gallstones; cancer of gall bladder, with metastases in liver; pericholecystitis.

Pathology—Carcinoma of the gall bladder

a meal, and shows no gallstones. The gall bladder must fill with the dye, concentrate it, greatly contract after a meal, and completely empty.

(2) There must be no blurring or fuzziness of soft tissue or bony outlines from respiration or movement.

(3) Bony detail in the lower ribs and vertebral bodies must be sharp-cut and distinct.

(4) Soft tissue outlines must be distinct. The entire border of the right lobe of the liver should be visible, which insures correct position and rules out situs inversus. The right kidney outline is always distinctly

visible, as well as the edge of the psoas muscle.

(5) The dye should be visible in the intestines unless an enema has been given. It is an advantage to be able to see the tetraiodophenolphthalein at the 12-hour examination as that proves the patient took the dye and retained it (did not lose it by vomiting or diarrhea).

(6) The area included on the films is from the right tenth rib to the hip joint. In "no shadow" cases, examine the spine closely as a gall-bladder outline may be hidden by the vertebral bodies, and the patient must be rotated in order to demonstrate the viscus.

(7) There should be maximum contrast—no gray-brown tints—yet the films must not be too dark. These are the two most frequent offenses. The first is caused by too high kilovoltage, the second by overexposure, which is often combined with under-development. Detail is consequently of poor quality, and slight shadows of pathology may be overlooked. Any film which is so dense that an unusually intense light is necessary in order to see through it is unsatisfactory, and should be discarded.

(8) Make enough films. A "no shadow" or "faint shadow" diagnosis on two or three films is the cause of most failures; or worse yet, the films available may be too dense. Such cases should be re-examined.

Concerning an important modification of the Graham test to permit more detailed study of the *contracted* gall bladder, it is of great consequence to examine the gall bladder after a meal, not only to demonstrate a strictly normal cholecystographic response but also to be certain that no small gallstones are being missed. The statement has been made that if a gall bladder fills with the dye, it can empty, which, of course, is obvious. But to claim that *therefore* no observation is necessary after a meal is to chance overlooking small calculi which are



Fig 4 Pericholecystitis. Cannot demonstrate normal contractility of the gall bladder after a meal; gall bladder fades away. The patient had pain in the epigastrium, radiating posteriorly and to the right. There had been recurrent attacks for 25 years, more severe of late. These attacks lasted about 24 hours and occurred every five or six weeks. The patient was never jaundiced; the abdomen was flaccid; there was tenderness on deep pressure over the gall bladder.

X-ray Examination.—Apparently normal cholecystographic response except that normal contractility after a meal could not be demonstrated.

Operation.—Gall bladder was slightly thickened; no stones; very dense adhesions between gall bladder, duodenum, and omentum.

frequently visible only in the greatly *contracted* gall bladder and after some of the dye has been evacuated. Deformity from adhesions is often brought to light as the gall bladder empties, and Kirklin (1) has shown the necessity of watching the gall bladder empty in the detection of small polypoid tumors. The usual method of making an examination an hour or so after the patient has taken food was found to be unsatisfactory, as frequently the gall bladder had already emptied and no shadow was distinguishable. We then began to make examinations immediately after the meal, following up with more frequent observations while the gall bladder still contained opaque dye. We found that one of the important characteristics of normal function in the gall bladder is *contraction after a meal to one-fourth its former size or even smaller than when*

fully distended, and the demonstration of this is of importance in ruling out pathologic involvement. Such evidence of normal function was found to be present in about one-third of the cases in which a shadow was obtained, and is more pronounced and easier to observe the more intense the gall-bladder shadow. On the few gall bladders found at operation to be pathologic but reported as negative after a Graham test (so-called false negative), we have never been able to demonstrate this maximum contractility after a meal. We believe that when it can be demonstrated, pathology can be safely ruled out. In such a viscus the muscular coats cannot be seriously infiltrated, and the extremely small size of the contracted gall bladder positively negates the presence of any gallstones. Such a finding of a greatly contracted but still



Fig 5 Type of gallstone demonstrated after dye "coats" it. The patient, 51 years old, complained of attacks of pain in the upper abdomen twice a week for nine months. There was jaundice during several attacks.

X-ray Examination—No gallstones in preliminary films. After dye, a generally contracted gall bladder, with poor function, was seen. Chronic cholecystitis.

Operation—Thick, small gall bladder with narrow, thin cystic duct containing a large, round, somewhat roughened, dark brown, solitary calculus, the size of a large marble.

plainly visible gall bladder has never been present in our experience when dense pericholecystic adhesions were found at operation (Fig. 4). In cases of faint shadow there is often sluggish contraction or none at all demonstrable, the gall bladder fading away soon after the meal, due to disease of the wall or the presence of stones. Occasionally, small stones which were hidden by the dense shadow of the distended gall bladder may be recognized after the gall bladder has contracted.

CHOLELITHIASIS

As stated on many occasions, gallstones are roentgenographically of two varieties, opaque and non-opaque. The opaque stones usually contain a varying percentage of cal-

cium and can be detected in the preliminary examination. This finding is many times sufficient for surgical indications, without the use of the Graham test. The visualization of the gall bladder, in addition, often brings to light many interesting details as to the condition of its wall, obstruction of the cystic duct, etc. But far more valuable than all is the state of the function of the gall bladder. It is surprising to see how often we have stones present in a gall bladder which has a fairly normal sequence. This in itself is extremely valuable as to the immediate surgical indication, for we are of the opinion that, given a case of opaque gallstones, we may be sure that there is considerable pathologic change in the gall-bladder wall and that removal is indicated. We have seen too many patients with known



Fig. 6. Visualization of the common duct at the 16-hour examination when it contains the dye. The gall bladder had been removed eighteen years previously. The pointed distal end of the duct where it passes into the intestinal wall is distinguishable.

chronic cholecystitis, with stones, postpone removal until an acute attack, with gangrene, carries them off.

The non-opaque stones are composed mostly of cholesterol or bile salts and have insufficient calcium content to be visible roentgenographically unless the dye has been given. If the gall-bladder shadow is obtained, the stone or stones appear as single or multiple sharp-cut, circular or squared dark spots within the white gall-bladder shadow. Opaque bile surrounds the non-opaque stone and visualizes it by contrast of shadow. A single large or small stone of this variety is usually seen in the fundus and can be made to move around by shifting the position of the patient, or at times simply contractions of the gall-bladder wall during emptying will change the location of the stone. Small polypoid tumors may be mistaken for calculi of this character. They

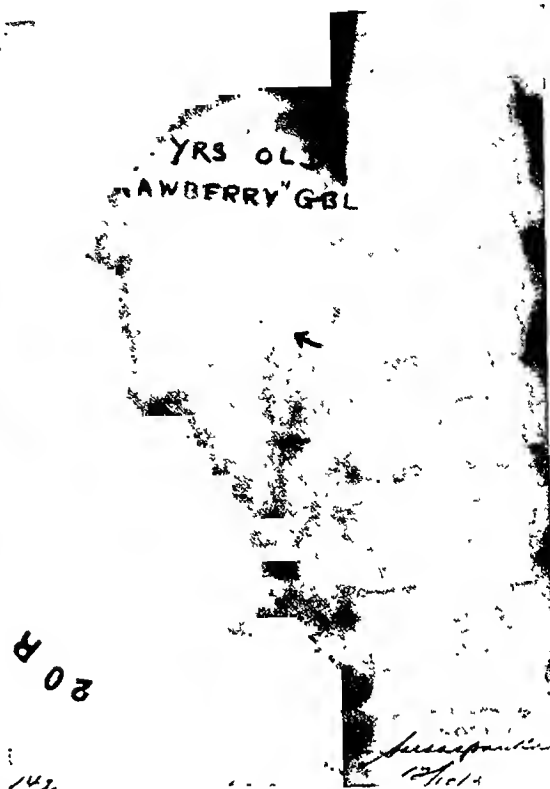


Fig. 7. "Faint" shadow of gall bladder, "strawberry" type. The patient was a boy 14 years of age, who complained of pain, with nausea and vomiting, for a year. There were slight rigidity and spasm in the right upper quadrant; direct tenderness over the gall bladder.

Operation revealed a gall bladder of double normal size; tense, with thickened wall; numerous adhesions to duodenum.

are usually seen near the edge of the gall-bladder shadow, however, and never change their position (Kirklin, 1).

At times it is difficult to differentiate the shadow of a large non-opaque gallstone from a bubble of gas in the colon. No single recent suggestion is of as much importance as the routine use of colonic cleansing between the twelfth and sixteenth hours after the dye. It clears out the gas and gives one an opportunity to make correct interpretation. Bubbles of gas in the descending arm of the duodenum are deceiving and may be mistaken for stones. Careful comparison of the entire series of films will usually clear up this differentiation as the mottled shadow of a gall bladder partially or completely



Fig. 8 Example of a "faint" gall-bladder shadow containing non-calcified gallstones. There are two huge stones in the neck of the very large gall bladder, resembling gas in the pyloric region and duodenal bulb; also many small stones in the fundus. The patient, 53 years of age, had had attacks of jaundice for the last two years; no pain. Operation revealed cholelithiasis and cholecystitis

filled with stones has a fairly constant appearance. If no gall-bladder shadow is obtained because the cystic duct is obstructed and the dye cannot enter the gall bladder, these stones cannot be recognized and the examination is reported as a "no shadow" case. It is well for the roentgenologist to appreciate that in fully 60 per cent of these patients stones are present, although he may not be able to demonstrate their presence. In reporting these cases, always state the above facts, otherwise one may be held responsible for not reporting stones found at operation.

As we have previously reported, we have had a number of cases of fairly large non-opaque stones located in the cystic duct which could not be recognized until a small

amount of the dye-impregnated bile worked its way around the stone and coated it sufficiently to render it visible (Fig. 5). Some of our colleagues have become so enthusiastic in producing a dense shadow at full concentration that they overlook the fact that small non-opaque stones can be overshadowed. If preliminary films are made before the dye is given, most opaque stones can be picked up; it is a safe rule, however, to examine both before and after the test as well as during the filling and emptying of the gall bladder.

Dr. Phemister, Dr. Rewbridge, and Dr. Rudisill, at the American Medical Association meeting held in Philadelphia in June, 1931, called attention to the very interesting fact that in obstruction of the cystic duct with cholesterol or bile pigment gallstones, large amounts of calcium carbonate may be deposited in the gall bladder or in the gall-bladder wall. In some instances there is a cast of calcium carbonate occupying the entire gall bladder. If the gall-bladder wall can assume such strange activity, one questions if it is not possible that in some cases a chemical change occurs in the dye-impregnated bile whereby there is a breaking up of the iodine content and destruction of the shadow-casting element. If this is so, it may account for some of our "no shadow" cases. Investigation along these lines is now under way.

PERSISTENCY OF THE SHADOW

In some cases the gall bladder fails to respond to the stimulus of food and does not contract and empty as it should. It is usually fairly reliable evidence of a deficiency in the muscular tone of the gall bladder. One sees "persistency of shadow" as a part of a general condition of asthenia, and it is often noted in cases showing marked 6-hour gastric retention after the barium. When the shadow disappears after food and again faintly appears 36 hours after administra-

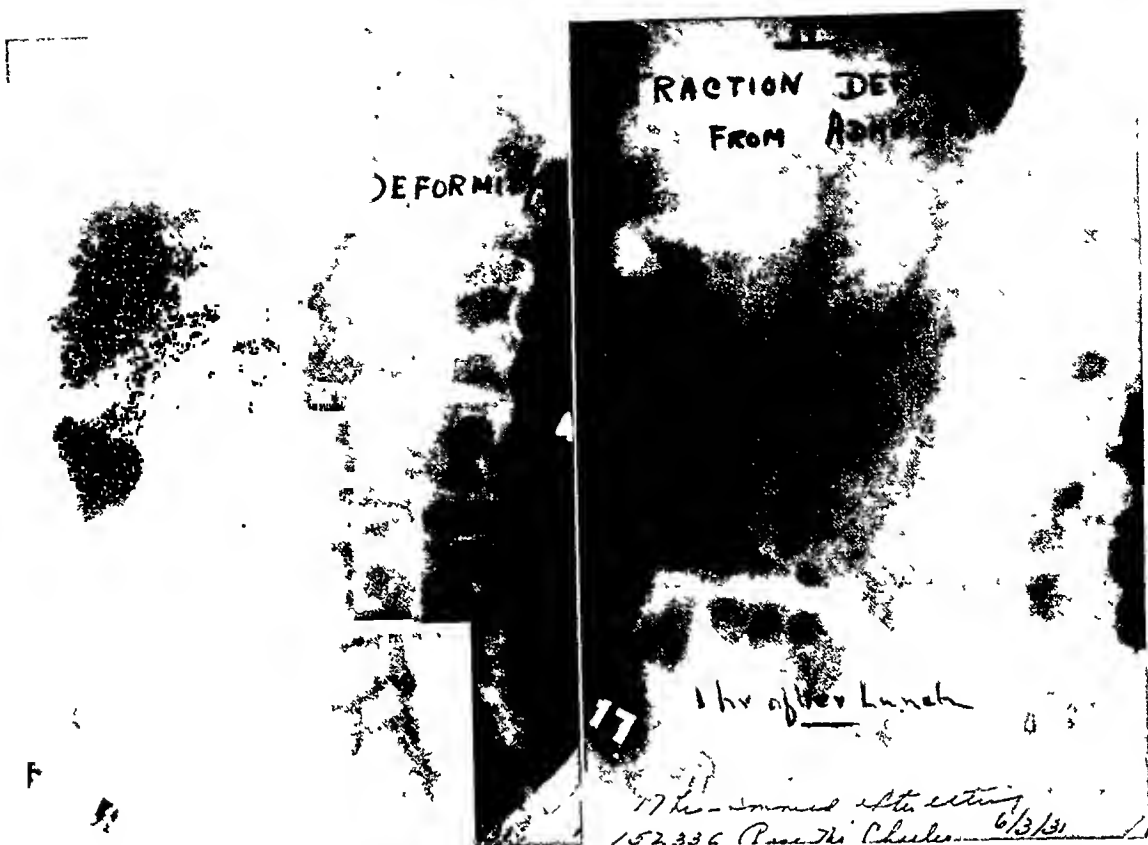


Fig. 9. Example of traction deformity from adhesions. The patient, 74 years of age, complained of attacks of pain in the gall-bladder region, sometimes lasting two weeks, with nausea and vomiting. "Gas" present; bowels regular; no jaundice.

X-ray examination revealed deformity and displacement of the gall bladder, with fixation from adhesions.

tion of the dye, it usually indicates reabsorption, and up to date we have disregarded the finding as of no importance.

Now and then a case will show what we call a "late appearance." It is rare, but in all of our series the gall bladder has proven to be pathologic.

VISUALIZATION OF THE DUCTS

The ducts are outlined commonly in contracted gall bladders after the meal. Even the spiral valves of Heister in the cystic duct are plainly distinguishable in favorable cases (Fig. 2-C). If a sufficient number of observations are made during the emptying of the gall bladder, one may be able to de-

tect pathology of the ducts. In one case we were able to visualize the common duct eighteen years after cholecystectomy—it showed a distinct narrowing at the ampulla of Vater (Fig. 6). In another patient we detected a non-opaque stone located in a dilated common duct, the gall bladder having been removed some years before.

FAINT SHADOW

What is a "faint shadow" and how can it be recognized? One knows that following the oral administration of tetraiodophenolphthalein the gall bladder slowly fills with the opaque bile, reaching full distention

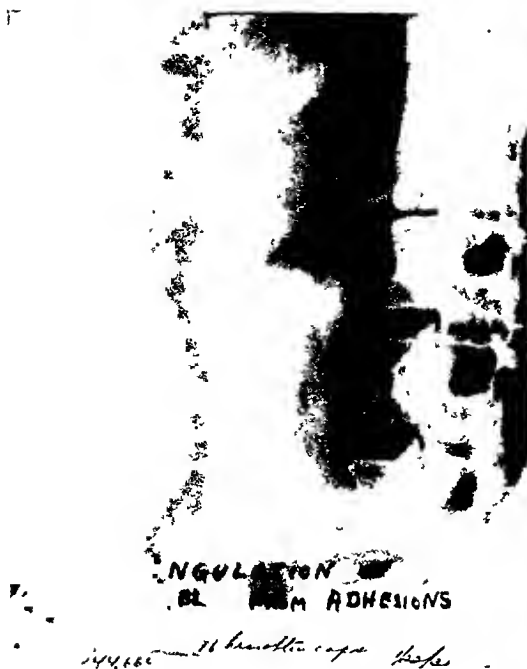


Fig. 10 Angulation of the gall bladder, with adhesions. The patient, 49 years old, had had attacks of severe pain in the gall-bladder region for the first time six years before examination and again two weeks before. Slightly jaundiced; no vomiting. X-ray examination showed a kinked, angulated, deformed gall bladder which functioned poorly; no gallstones.

in about twelve hours; that one of its main functions is to absorb some of the liquid portion of the bile, leaving the remainder much stronger in its solid constituents. This concentration occurs about sixteen or seventeen hours after giving the dye. The normal shadow at this observation is smaller and much more dense than that seen at the twelfth hour and is the shadow that one establishes as the "standard." From this known density one can recognize variations. There are, of course, shadows which are not so dense as the "standard" and still are within normal limits; these are sometimes difficult to evaluate but long experience will render the distinction recognizable. In our early studies we made comparison between the shadows of surgically proven pathologic gall bladders and the standard, and soon established a density which we felt



Fig. 11. Clinical diagnosis was acute cholecystitis. The gall bladder functioned normally after the Graham test. A barium clysma demonstrates a high cecum which has never descended. The patient has had pain in the right side for the past three weeks, with moderate fever; vomited once; tenderness in right upper quadrant. Clinical opinion was gall-bladder trouble.

X-ray Examination.—Negative Graham test. High, non-rotated cecum (tender); appendix not outlined. Operation revealed appendiceal abscess under the liver.

we could definitely state to be a "faint shadow" (Fig. 7). The ability to recognize this finding can be perfected by a close comparison of the normal with the density of those gall-bladder shadows known by the presence of visible gallstones (Fig. 8) to be pathologic. One must bear in mind in this interpretation that technical factors may vary within wide limits, and two examinations on the same case may result in somewhat different findings. Considerable depends on whether or not the fasting period has been broken; whether there has been vomiting or diarrhea, and, finally, on whether or not the dye is visible in the 12-hour

films. We are often compelled to refuse to attempt a diagnosis on only a single examination which has resulted in a "faint shadow," unless there are stones, jaundice, or some other acceptable cause accompanying this finding. The safe rule is to make a re-examination in any suspicious case, as more will be learned by repeating the test than in any other manner.

What does a "faint shadow" indicate? If we assume that opaque bile enters the gall bladder, then a "faint shadow" must indicate one of three things:

(1) That the gall-bladder wall is so thickened from an old chronic inflammation that the density of the shadow of the dye-impregnated bile is lessened (Fig. 7).

(2) That the gall bladder is so packed with stones as to allow only a small amount of the opaque dye to enter. This is a very frequent finding in chronic cholecystitis with stones (Fig. 8).

(3) By far the greatest number of faint shadows result from some interference with the normal function of concentration. This is especially true in acute cholecystitis or an acute exacerbation in an old chronic case. This loss of function is due to the crippled condition of the mucous membrane because of inflammatory changes, which may be of varying degree, so that our shadow often passes all the way from faint to none at all. Bronner and Schüller (2) believe that on account of the inflamed membrane in acute cases this finding is due to increased ability of the gall-bladder wall to absorb "contrast bile." We have never been able to recognize this occurrence and have had the feeling that events in the gall bladder follow the same routine as in other mucous membranes throughout the body, namely, in the presence of an acute inflammation there is considerable edema and that edema in tissue decreases rather than increases absorption. Their contention, however, is supported to a considerable extent by Iwanaga (3), who



Fig 12. Clinical diagnosis was acute cholecystitis; roentgen findings demonstrated normal cholecystographic response and duodenal ulcer. The patient, 45 years old, had had pressure pain for the past year in the epigastrium, radiating to the right upper quadrant and back; nausea; no vomiting; anorexia.

X-ray Examination—Normal gall bladder by Graham test. Marked and persistent deformity of the duodenal bulb from ulcer.

has called attention in his animal experiments to the fact that traumatic or bacterial inflammation of the gall bladder gives rise to increased absorption of the bile. Rosenthal and Licht (4) seem to be of the same opinion, they having expressed themselves as convinced that there is an increased absorption of bile acids in acutely inflamed gall bladders.

We must not fail to recognize that there are many cases of old sclerotic gall bladders, in which the function of concentration is defective, resulting in a faint shadow.

That we may have a varying degree of inflammatory change from normal to badly damaged mucous membrane in the same gall bladder is conceded, but we do not believe that this will influence the character of the general shadow. Kirklin, Caylor, and Boll-

man (5) have found that concentration in the gall bladder is the sum of the activity of the entire organ, and that diseased portions may be found in a gall bladder without noticeably influencing the concentrating power of the organ as a whole.

cases, but the authors firmly believe that when a "no shadow" finding is obtained and verified, it means that the cystic duct is obstructed, provided, of course, that the bile is opaque to the X-ray. If it is not opaque, there is interference with the normal func-



Fig 13 Cancer of the colon mistaken for cholecystitis. The patient, 56 years old, complains of cramp-like pains in the right upper quadrant, which have been present for four months. He has lost fifteen pounds in weight during the past year.

X-ray Examination—Stomach, duodenum, and gall bladder are negative. Clysmia reveals "napkin-ring" cancer of hepatic flexure. At operation, a hard, annular tumor of hepatic flexure, the size of a lemon, was found firmly fixed to the under surface of the right lobe of the liver.

Pathology—Adenocarcinoma of the hepatic flexure, with metastases in the regional lymph nodes.

That there are other individual causes for faint shadow, there can be no doubt. The important fact is that, regardless of whether the dye is given orally or intravenously, the finding of a faint shadow usually indicates pathology. It should always be carefully studied and checked by at least one re-examination, especially if surgical interference is contemplated.

NO SHADOW

The above remarks concerning "faint shadow" apply in a measure to "no shadow"

tion elsewhere in the biliary system than in the gall bladder. All are agreed that gallstones are the most common cause of cystic duct obstruction, but what explanation can be offered for the case with a patulous cystic duct and still "no shadow" is present? In such a case what is preventing the opaque bile from entering the gall bladder? It must be conceded that no single explanation can account for all of the cases in this group. We are firm believers in spasm or edema of the cystic duct accounting for many cases of "no shadow" on the first examination in which a

shadow is present on re-examination. Constriction from adhesions accounts for some obstructive cases and extrinsic pressure from tumor or inflammatory masses may produce obstruction in certain cases. Allowing for these exceptions, there are still a number in which the explanation must be more or less theoretical. A number of possibilities have been offered.

(1) The inflammatory process in the gall-bladder wall (cholecystitis) causes more rapid absorption of the dye than normal, so that by the time the films are taken, the percentage of iodine in the opaque bile mixture is not sufficient to render the gall bladder visible (Bronner and Schüller, 2).

(2) The inflammatory process inhibits cell activity so completely that water is not absorbed and the dye is not concentrated (Chiray and Panel, 6).

(3) The inflammatory process causes breaking up of the bile-dye combination; the toxic products interfere with the chemical union of the dye and bile (George Rohdenberg, 7).

(4) The wall of the gall bladder is abnormally thickened, the lumen is smaller, and there is insufficient opaque bile-dye content to cast a shadow.

(5) Bile is abnormally thickened (tarry or axle-grease consistency) and not miscible with the dye.

(6) The gall bladder is so filled with non-opaque stones that an insufficient amount of dye-impregnated bile can enter the gall bladder to give a shadow, even though the cystic duct be patent.

(7) It is possible that some disturbed physiological action between the gall bladder and the sphincter of Oddi may prevent opaque bile from entering the gall bladder (Naunyn), but this has never been demonstrated.

(8) Kirklin (8) claims a meal containing fats in the evening just before taking the dye (oral test) results in 25 per cent

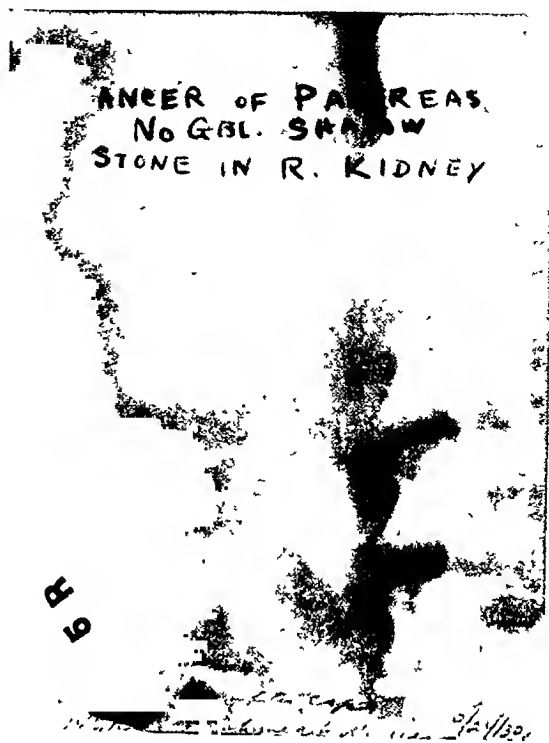


Fig. 14. Illustrating kidney stone found on routine Graham examination. The patient had had pain in the abdomen for the past seven weeks, and had been confined to bed for four weeks. Frequent vomiting; liver enlarged on examination; no shadow on Graham test; renal stone.

Operation—Liver large, pale yellow; gall bladder hidden in dense omental adhesions; large hard mass in the head of the pancreas; stone could be palpated in the right kidney.

more cases of "faint or no shadow" than if a fat-free meal is allowed.

(9) Lahey and Jordan (9) blame the colon and state that "in 44 per cent, in a series of 65 cases, the gall bladder filled normally after 5 to 10 days of bowel management; whereas, with the same intravenous technic it had previously shown an absence of filling or inadequate filling." Why functional or spastic irritability of the colon should have any influence on *intravenous technic* does not seem clear, since the dye is administered directly into the circulation, but in any event, a large percentage of cases, nearly half, required re-examination to obtain a normal shadow, when there was presumably no disease of the gall bladder. It



**intestinal obstruction from
appendicular abscess clinical
diagnosis acute g. bl.**

Fig 15 Clinical diagnosis was acute cholecystitis but roentgenograms demonstrated intestinal obstruction. The patient complained of diffuse abdominal pain, with vomiting, pain in epigastrium (no relation to meals); abdomen moderately distended.

X-ray Examination—Dilated intestinal coils

Operation—Acute appendicitis, with pelvic peritoneal abscess, acute ileus due to inflammatory adhesions of the lower ileum

is interesting to conjecture whether a spastic colon may produce or be associated with a spastic cystic duct

(10) Kretschmar (10) has a tabulation of 19 cases of "no shadow," three of which gave a normal shadow on repeating the test (intravenous technic)

Defective liver function, hepatitis, or cirrhosis may in rare cases prevent the bile from becoming opaque. That there will always remain a certain number in which an explanation of "no shadow" is impossible, there can be no doubt.

DEFORMITY OF THE SHADOW

Throughout the last five years' experience in cholecystography we have noted with in-

creasing frequency deformities of the gall bladder shadow of varying nature; elongations, sacculations, folds, angulations, constriction, etc., have been observed in gall bladders which gave a normal response to the dye. We have concluded that they are in the nature of anomalies, and this opinion has been sustained by the study of many cases operated upon. However, one must distinguish between deformities of this class and those caused by pericholecystitic adhesions. In the latter, there is usually a malposition, with or without evidence of traction (Figs. 9 and 10). The long axis of the gall bladder is commonly directed inward, instead of downward or outward. The edges of the shadow are apt to be roughened and irregular, especially in the presence of stones.

With a typical normal response to a meal the gall bladder contracts to about one-quarter its size when distended. Such a finding rules out any dense adhesions from pericholecystitis, but a "fadeaway" emptying, without any evidence of contraction, is strong supporting evidence of adhesions involving the serous coat.

Beware of those cases which give a perfectly normal cholecystographic response without deformity and still have persistent drawing pain. We have seen such findings in at least six cases. About the only roentgenographic signs are a slight malposition of the gall bladder with possibly some tenderness and fixation when palpated under the screen. However, the gall bladder is normally so closely attached to its liver bed that efforts to demonstrate fixation by palpation are very difficult; in fact, we have found fluoroscopy almost impossible unless the subject is very favorable. In all these cases the gall bladder was found embedded in omental adhesion.

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS BY MEANS OF THE GRAHAM TEST

Patients referred for X-ray examination

of the gall bladder fall roughly into three groups:

(1) Those in whom the clinical symptoms are typical, the diagnosis of acute gall-bladder disease has already been made clinically, and there have been attacks of unquestioned biliary colic, the X-ray examination being made simply for what additional information it may yield.

(2) Those with vague, indefinite abdominal distress whose main complaint is gas, belching and flatulence, with very little pain, in whom the X-ray examination is made with the hope that it will lead to a positive diagnosis or else rule out organic disease

(3) Lastly, those with no gall-bladder complaint, in whom a thorough search is being made for focal infection or as part of a clinical "work-up" The gall bladder may not even be under suspicion, but gallstones have been found during a routine examination of the gastro-intestinal tract, urinary system, or spine.

In the first group, there is only rarely any failure to confirm the clinical diagnosis, but in the second and the third groups the differential diagnosis is more difficult and the Graham test is often of great value. It is in these cases that the clinical history and findings may be very indefinite, while the X-ray, when positive, is of real aid in establishing a correct diagnosis. Moreover, while one lesion is usually the cause of the patient's symptoms, especially in acute manifestations, yet in chronic cases there may be two or more lesions. Chronic appendicitis and chronic cholecystitis are frequently associated; so are chronic pancreatitis and chronic cholecystitis or duodenal ulcer with chronic cholecystitis. With such multiplicity of lesions, the history and findings may be extremely confusing, while the X-ray gives impartial visualization of the existing pathology.

The most common double lesion is chronic



Fig 16 Echinococcus cyst; cholelithiasis and cholecystitis. The patient, 60 years of age, for several years has had occasional attacks of pain in the right upper quadrant, radiating to the back and the shoulder blade; nausea but no vomiting, frequent gaseous eructations, with relief from pain, anorexia.

X-ray Examination—Mass just above and to the outer side of the gall bladder, which is calcified, probable echinococcus cyst; non-opaque gallstones.

Operation—Echinococcus cyst and gallstones.

cholecystitis and chronic appendicitis. When the cecum fails to descend into the iliac fossa, the appendix may be in the right upper quadrant and defy differential diagnosis without the X-ray (Fig. 11).

Duodenal ulcer may accompany gall-bladder disease (Fig. 12), but it is more often found as a single lesion when the gall-bladder disease has been diagnosed clinically. Such findings are so frequent that the stomach and duodenal bulb are routinely outlined following the Graham test. It has been stated by some authors that in the presence of duodenal ulcer the cholecystographic findings in the vast majority of cases will be



Fig 17. Echinococcus cyst. The patient, 40 years of age, has complained for 19 months of pain and burning in the stomach upon taking food. He has lost fifty pounds in weight in the last two years. Has a mass beneath the liver the size of an orange.

X-ray Examination—Gall bladder is displaced upwards by a rounded mass; lower rim is calcified.

Operation.—A cyst in the lower border of the right lobe of the liver.

Pathology—Echinococcus cyst of the liver.

“no shadow.” Our experience does not justify such a statement. When we obtain a “no shadow” in the presence of a duodenal ulcer, it is usually due to a double lesion.

Gastric ulcer and cancer frequently give symptoms referable to the gall bladder. Even the best of internists would not venture in many cases to make the differentiation without the aid of the roentgen examination, and these remarks are pertinent to cancer of the colon, a palpable mass being taken for an enlarged gall bladder (Fig. 13).

Cancer of the pancreas, gall bladder, and liver usually results in a “faint shadow” or

“no shadow” on examination with the Graham test, and differential diagnosis cannot be made (*i.e.*, with the Graham test). This gall-bladder finding, in the opinion of the authors, is due to associated pathology.

A stone in the right kidney may present a strikingly similar clinical picture to gall-bladder disease. Kidney stones present a variety of forms, from round or oblong to those with sharp, spike-like projections, usually quite dense, while gallstones are typically ring-like or faceted when calcified. The oral Graham test is a much more simple differentiating test than pyelography. We may have a double lesion as in Figure 14. This patient suffered from a carcinoma of the head of the pancreas, as well as nephrolithiasis. The gall-bladder finding was “no shadow,” due to adhesions.

Small intestinal obstruction, with cramps, may be confused with biliary colic. Here a single film of the abdomen demonstrates the distended intestinal loops (Fig. 15).

An echinococcus cyst of the liver is occasionally seen, causing symptoms that are difficult to differentiate, without cholecystography, from a gall-bladder lesion (Figs. 16 and 17).

SUMMARY

(1) The most efficient technic for oral cholecystography of to-day as a result of five years' experience has been outlined.

(2) Every “faint shadow” and “no shadow” finding should be re-examined for confirmation as a routine.

(3) Maximum contractility of the gall bladder after a meal must be demonstrated as part of a normal cholecystographic response and to rule out pathologic involvement.

(4) Theories are outlined for cause of “faint shadow” and “no shadow.”

(5) Cholecystographic findings in various lesions of the biliary tract are men-

tioned, with illustrations of differential diagnosis.

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IRRADIATION OF TUMORS, WITH SPECIAL REFERENCE TO RADIOSENSITIVE TUMORS¹

By MAX KAHN, M.D., BALTIMORE, MARYLAND

THIS brief review is based on the experience of nearly eight years, during which we have irradiated certain types of tumors with superficial and deep X-ray. Most of the experience was obtained in the treatment of cases observed both by Dr. Bloodgood and the author, and the diagnosis was based on clinical, X-ray, or microscopic evidence and not infrequently on all three. Dr. Bloodgood published a thorough review of radiosensitive tumors in *RADIOLOGY* in March, 1930. The present review is chiefly of tumors considered inoperable, most of them large and either inaccessible or not easily accessible by operation. As a rule, the more malignant the tumor the more radiosensitive it is likely to be; for example, lymphosarcoma and certain other types of sarcoma—embryonal cell sarcoma. There are some exceptions, which will be mentioned later in the case reports. Of the curable types of tumor, basal-cell cancer is well known to yield to irradiation, and since this type of cancer frequently attacks the skin superficial irradiation is usually sufficient to bring about a cure. Basal-cell cancer is mentioned simply to call attention to the fact that irradiation as well as surgery will produce a cure, and also that it falls in the radiosensitive group. When properly treated either by X-ray or surgery, it seldom recurs. Fibromas or fibrosarcomas belong to a type of tumor more or less radiosensitive, and, while some of them will yield to irradiation and the patient remain clinically well for five years or more, others are only temporarily benefited, recur, and have to be surgically removed. Tumors of this type, therefore, fall in the group of moderate curability and

it is always advisable to try irradiation before operation. Such a tumor is somewhat slow-growing and not infrequently involves the nerve sheath. One case of fibromyxoma of the antrum and nares and another case of fibromyxosarcoma involving the antrum and ethmoidal region, treated with the deep X-ray, are up to the present time clinically well at two and two and a half years, respectively. These, with a few other cases, are taken from a large number of various types of tumors treated in the past eight years, and are reported because they present points of unusual interest. No attempt has been made in this study to make it embrace a complete review of radiosensitive tumors.

CASE REPORTS

Case 1. This case is extremely interesting as being an instance of a markedly radiosensitive tumor which proved highly malignant. The patient, H. J. R., white male, aged 56, consulted Dr. Bloodgood in April, 1930, about a growth on his forehead, which had been present for about ten or eleven months. When first noticed it approximated the size of the end of the index finger. It has slowly grown to the present size, occasioning no actual pain, no headaches. The patient feels a little uneasiness there, and cannot wear a hat on account of pressure. The trouble had been present about three or four months before he consulted a physician, who advised leaving it alone, and the case, therefore, received no treatment until January, when the man consulted another physician, who gave him injections in the arm without result.

On physical examination a large palpable tumor was found in the abdomen, and the

¹Read before the Radiological Society of North America, at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1-5, 1930.

patient complained of indigestion. He also had a tumor of the right testicle which had been present for eighteen months. The right testicle was surgically removed by Dr. Bloodgood on April 8, 1930, and the

to return in June with a recurrence of the tumor on his forehead and the tumor in his abdomen. A second course of irradiations was given, and, while both tumors regressed somewhat, he gradually grew weaker and



Fig. 1. Case 1. Metastasis to the frontal bone and the overlying soft structures from sarcoma of the testicle. Before deep irradiation.



Fig. 2. Same case as shown in Figure 1. Note the rapid regression of the soft-structure tumor five days after deep irradiation. There was evidence also of some improvement in the metastasis to the frontal bone.

microscopic sections revealed a highly cellular embryonal type of sarcoma. X-ray examination of the head revealed destruction of the frontal bone, particularly of the outer table immediately above the frontal sinuses, with infiltration and swelling of the overlying soft structures. The abdomen revealed no demonstrable tumor nor calcification, although a mass was easily palpable. Deep irradiations were begun in April, 1930, first over the forehead and then over the abdomen. The mass over the forehead rapidly became smaller and flattened out, whereupon we could feel the roughened bone beneath. Similarly, the mass in the abdomen rapidly disappeared so that it was no longer palpable, and the patient's symptoms of indigestion disappeared about this time. He felt better after the course of irradiations than he had done for months. He went to his home in another city, only

died in July, 1930. This case is reported somewhat in detail because of the extreme radiosensitiveness of the metastatic tumors of both the forehead and abdomen, associated with a high degree of malignancy.

Case 2. A somewhat similar case, the patient having a tumor of the testicle, with metastasis to the abdomen. He is living and clinically well after seven and a half years. The patient, G. W., a white male, aged 42, married, entered the hospital in July, 1923, complaining of pain in the abdomen and in the right lumbar region radiating to the right ureter. On examination, the left testicle was found to be apparently normal. The right testicle was absent. There was a spherical mass in the upper abdomen which seemed to be fixed and very rigid. When palpating the kidney area on either side, the mass—about the size of a grapefruit and near the mid-line—did not move.

X-ray examination of the chest was negative, revealing no evidence of metastasis. X-ray studies of the gastro-intestinal tract revealed difficulty in filling the pylorus and duodenal bulb, due to pressure from an

who removed the right testicle in March, 1923, stated that section of the tumor revealed an embryonal type of carcinoma. He also stated that an inguinal adenitis was present one year prior to the appearance of



Fig. 3. Case 3. Metastasis in the region of the right hilus, with a curved metastatic shadow extending upward and outward to the periphery, following surgical removal of an ovary for sarcoma. Before deep irradiation.

extra-gastric tumor. There was also some degree of ileal and cecal stasis. An exploratory operation was done by Dr. George A. Stewart, whose note follows: "Right rectus incision—exploration of the abdominal cavity. Nothing in the scar or gall-bladder region but near the mid-line in region of the kidney there lay a large mass which was nodular in character and lay beneath the peritoneum. There was no glandular enlargement. It was impossible to move this mass freely and we could not trace a direct communication with the kidney itself on this side. The entire mass was in such a position and seemed so large and near the large abdominal vessels that we did not believe it advisable to remove it. No glands could be obtained for diagnosis. From the previous history we thought this to be a malignant metastatic tumor, although we could not get a section." A brief note from Dr. J. McRea Dickson, of Gettysburg, Pa.,



Fig. 4. Same case as shown in Figure 3, five years after deep irradiation. The lungs are clear and there has been complete disappearance of the metastatic shadows. Patient is clinically well.

the growth. The patient received deep X-ray treatments during August, September, and October, 1923, and also during October, 1924, but none since. He was seen at the office about five years after irradiation and at that time there was no palpable tumor in the abdomen and he was clinically well. In answer to a recent inquiry, Dr. Dickson, under date of October 28, 1930, now about seven and a half years after irradiation, writes as follows: "I saw Mr. W. about four months ago. There has been no return of the tumor and he is apparently cured." There is undoubtedly a similarity between these two cases of embryonal cell tumors, with the exception that the second

had no metastasis other than in the abdomen, while the first had metastases to the abdomen and to the skull. Both yielded rapidly to irradiation and were extremely radiosensitive. In one case the patient died

in the region of the hilus, gradually extending upward and outward toward the periphery. There was marked infiltration in the region of the right hilus, with a widened mediastinal shadow extending upward.

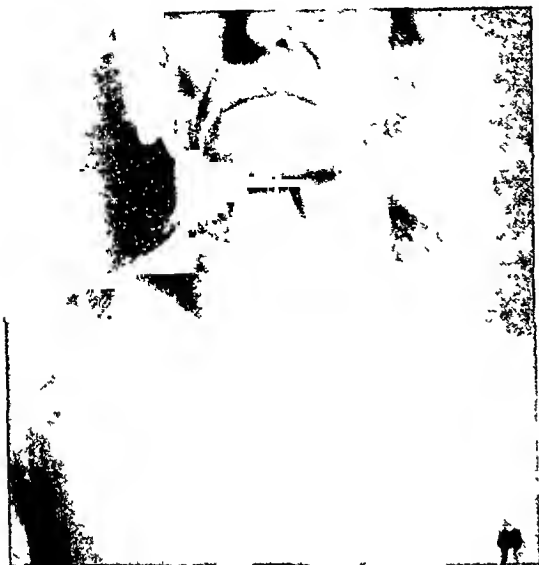


Fig 5 Clinically, a case of cystadenoma of the thyroid before deep irradiation, showing how pressure has produced distention of the superficial veins.

about three and a half months following the first course of irradiation, while the other patient is living and clinically well and apparently cured seven and a half years later.

Case 3. Miss M. B., white female, aged 64, was first seen by Dr. Bloodgood in September, 1925. Three years before she had been operated upon by Dr. William J. Coleman for appendicitis and he had found also a sarcoma of the ovary. On physical examination she was seen to have numerous warts, beginning in the mid-line of the abdomen and extending to the chest. There was also a mass in the right upper quadrant of the abdomen. Her chief complaint was dyspnea, but otherwise she felt well. X-ray examination of the chest revealed a dense curved line, corresponding approximately to the region of the right upper and middle lobes. This dense line appeared to originate



Fig. 6 Same case as shown in Figure 5. Note the infiltration and extension of the cystadenoma to both apices, particularly the right.

There appeared to be also some increased widening of the left upper mediastinum. X-ray examination of the abdomen revealed no tumor shadows, and both kidneys were visualized and appeared normal in size and position. Dr. Bloodgood studied the sections of the tumor removed by Dr. Coleman and his note on the sections is as follows: "It is distinctly a sarcoma; cells larger than lymphosarcoma. It belongs more to the endothelial sarcoma type, not unlike Ewing's type of endothelial myeloma of bone. This tumor reacts readily to radium and X-ray."

The patient received deep irradiation over the lungs and mediastinum from September to November, 1925. She responded to irradiation rapidly so that the dense shadow

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This case illustrates that the tying of the external carotid arteries, combined with deep irradiation, has produced a marked improvement in a case of fibromyxoma, so that the patient is now clinically well, two and a half years after treatment.

Case 5. The patient, O. J. O., a white male, aged 28, stated that he had been absolutely well in every way until January, 1928, when, he believes, his trouble began with a bad cold which settled over his left eye. He consulted a physician about that time who told him he had sinus trouble, and the left sinus was drained two or three times. The condition cleared up and he was not troubled again until the following March. The same symptoms returned at this time, with watering of the eye, and he felt as if the eye was being pushed out of the socket. He had headaches over the left frontal area extending to the occiput. He returned to his physician, who treated him again for the left frontal sinus and the symptoms cleared up, but the left side of his nose felt "stopped up," and since then he has been unable to breathe through the left naris. His physician removed a piece of the turbinate in May, 1928, which revealed chronic inflammation, and after that time the patient had little trouble until three weeks previous to our examination. About August 1, 1928, he noticed a swelling of the left side of his face and a little swelling inside his mouth. He was first seen by us on August 11, 1928, and at that time there was a slightly visible swelling of the left side of the face over the left antrum. In his mouth we saw a swelling larger than a twenty-five-cent piece of the left upper jaw. The first and second molars had been extracted, the third was still in place. The tonsils were large. On palpation the mucous membrane over the tumor was smooth and beneath it one could palpate a mucous mass with a bone shell. X-ray examination of the sinuses made elsewhere four weeks before revealed clouding

of the left antrum, with a suggestion of partial destruction of the anterior wall. He was operated upon by Dr. Bloodgood on August 15, 1928, a brief abstract of whose operative note follows: "An intramural in-



Fig. 8 Same case as shown in Figures 5 to 7. There has been marked absorption in the region of the apices of the infiltration from the cystadenoma of the thyroid, following deep irradiation.

cision along the upper lip to the nose was made, partly excising the external tumor with the cautery. The frozen section revealed sarcoma. On opening the antrum with cauteries (electric, Cameron and plumber's irons), it was impossible to remove all the tumor, as it extended behind the orbit and into the ethmoids. The tumor left behind was coagulated, but all of the tumor was not destroyed with the cautery. Microscopic examination revealed sarcoma of the antrum, round-cell in type, beginning in a fibromyxomatous tumor."

He received a course of deep X-ray irradiation in August and another in November, 1928, over the left antrum and left ethmoi-

in the lung and the widened mediastinal shadows disappeared. The warts on the abdomen were excised by Dr. Bloodgood in December, 1925, and proved to be benign pigmented moles. The patient was seen at long intervals and was also under the care



Fig. 7. Same case as shown in Figures 5 and 6, showing regression of the cystadenoma of the thyroid after a course of deep irradiation. Pressure has been relieved and distention of the veins has disappeared.

of Dr. John T. King, who in a personal conversation recently stated that the mass in the right upper abdomen has remained about the same in size and is symptomless. Following irradiation over the chest the patient has had no recurrence of dyspnea. X-ray examination of the chest made in October, 1930, five years after irradiation, reveals the lungs and mediastinum to be essentially negative. The patient feels well and is able to attend to her usual household duties.

This case is an illustration of a metastatic malignant tumor involving the lungs and mediastinum, clinically well and symptom-free five years following irradiation.

Case 4. H. S. M., Jr., a white male, aged 15, had his tonsils and adenoids removed in October, 1927. At that time he was breathing badly, mostly through his mouth. One month later he had bleeding from the nose—

three hemorrhages. At examination, when first seen in August, 1928, he was still breathing through his mouth. There was swelling of the right cheek, extending from the region of the zygoma down to the lower jaw, causing slight bulging of the eye and marked bulging of the right cheek. On palpation with one finger inside the mouth and one out, a small irregular mass which slid underneath the fingers could be felt. High up in the right side of the nose a grayish mass could be seen. He had had several epistaxes at infrequent intervals. Dr. Bloodgood's impression was that we were dealing with a tumor palpating like a multiple fibromyxoma and involving in all probability the nasopharynx, antrum, cheek, and temporal fossa and that it was not malignant. X-ray examination of the nasal accessory sinuses revealed, chiefly, clouding of the right maxillary sinus and right naris, strongly suggestive of a tumor, with some displacement of the nasal septum to the left. The walls of the maxillary sinus appeared intact. The heart and lungs were negative. On August 15, 1928, both external carotid arteries were ligated. A course of deep X-ray irradiation was begun during August, 1928, after ligation of the carotids, repeated again in January, June, and October, 1929. The epistaxis stopped immediately after the first X-ray treatment and has not recurred. The swelling of the right cheek and bulging of the eye gradually subsided, as well as the mass in the right side of the nose. X-ray examination of the nasal accessory sinuses in October, 1929, revealed decided improvement in the appearance of the right maxillary sinus, in that it was clearer and the walls of the antrum were better defined; there was also less clouding of the right naris. Dr. Bloodgood saw this patient in March, 1930, and noted that the swelling of the right cheek and bulging of the eye had gone and that the patient was breathing through the right naris.

doubt the possibility in all cases of determining radiosensitiveness by the microscope, and I have ample evidence to back up that opinion. Take the so-called "Ewing tumors"—a bad name because it does not describe the tumor; some are sensitive and some are not. Among

patients radiated in exactly the same way, some will die without the radiation having had apparently any effect on the tumor, and in others the tumor will disappear. Our microscopic slides do not tell us always the biology of the tumor.

ATOMS ARE WANDERERS EVEN IN SOLID METAL

Atoms, even the heavy atoms of lead, are wanderers. Prof. J. G. von Hevesy, of the University of Freiburg in Breisgau, has been investigating their properties. Lead atoms are constantly in motion, even in solid metal, he believes. In an alloy of lead and

gold, at a temperature half again as high as that of boiling water, the atoms wander through a space of a hundredth of a cubic inch in a day. When there is nothing but lead in the lump, however, moving about is not nearly so easy; in pure lead an atom can migrate in one day through a space of only two ten-billionths of a cubic inch.—*Science Service*.

dal region. X-ray examination of the chest revealed no positive evidence of metastasis, and X-ray examination of his sinuses on November 24, 1928, revealed the frontal sinuses unequal in size and a little hazy, probably due to the hypertrophied mucous membrane. There was destruction of the left maxillary sinus and malar bone—it was difficult to tell how much of this was due to surgical intervention and how much to neoplasm. The swelling over the left side of the face became less and gradually receded, soon after the first course of treatments.

The patient lives in a distant city and has written at various intervals, reporting his condition. In his last report in July, 1930, he states that he is in the best of health.

This case illustrates a patient with a round-cell sarcoma in a beginning fibromyxomatous tumor involving the antrum, who had an exploratory operation and who is now living and well two years following deep irradiation.

In conclusion, I wish to call attention again to the fact that the highly malignant tumors are usually also highly radiosensitive, and do not necessarily offer a bad prognosis. On the contrary, I desire to emphasize that deep irradiation offers much hope in some types of malignant tumors and that irradiation is the method indicated in those cases in which the location of the tumor makes the lesion inoperable or its complete removal impossible.

DISCUSSION

DR. FRANCIS CARTER WOOD (New York): Dr. Kahn's paper illustrates admirably the position in which we now find ourselves able to cure without any surgical intervention a certain number of cases which, ten years ago, would have been absolutely incurable: there is no question about it. Unfortunately the numbers are few, but the results are certainly definite. In regard to the fibromyxoma of

the nasal passages, in that case the operation of ligation of the external carotid could have been omitted, because it is perfectly well known that those fibromyxomas yield admirably to radiation by insertion of radium needles—an effective method, especially if the tumor is large and the needles can be inserted directly. If you can get near the base, the whole tumor will often disappear in the course of a few weeks. If it is not possible to get an approach to the tumor, external radiation will usually cause it to yield, in my experience, in a very short time without the necessity of interfering with the circulation.

Unfortunately, our diagnosis of the testicular tumor is still complicated by a series of names. We speak of "embryonal sarcoma"—it means one thing, and a "seminoma" probably means the same thing. We all know that the tumors known as "seminomas" are extraordinarily sensitive to radiation and are not good subjects for surgery, because the growth metastasizes early, often before the patient comes to the surgeon, and frequently before the patient will consent to operative removal of the affected testicle. Most of these cases show abdominal metastases and if the patients are heavily radiated they will sometimes be cured. Sometimes the tumors recur and are not sensitive, and the patient goes the usual course. On the other hand, the definite teratoid types, with carcinoma, are, as a rule, absolutely resistant to radiation, even in enormous dosage, and in patients with such neoplasms, while occasionally the pain may be palliated for a few months, death almost always follows within a year. Thus the importance of biopsy and careful study of our slides is obvious. What I wish to insist upon is that every patient has a right to a biopsy and it should be the medical-legal obligation of the surgeon to preserve a series of slides for future study for the benefit of that patient. Every case furnishes a little information for our future work, and if slides are carefully preserved as records, photomicrographs can be made and included with every published report, so that we can ultimately get some more definite information concerning the radiosensitiveness of these disease processes. As you know, I

so that others may plot the curves in suitable form for the most convenient comparison with other such curves, or for other methods of analysis.

DIFFICULTIES IN THE SINGLE VALUED SPECIFICATION OF QUALITY

Under some conditions it is entirely feasible to describe the quality of a heterogeneous beam of radiation by a single number. In any case in which the wave length intensity distribution is uniquely determined by a single variable factor the quality may be completely specified by giving the numerical value of that factor. It is well known that the quality of the total radiation emitted in a single direction by the target of a given

X-ray tube, operated at constant potential, is determined by the value of the voltage on the tube. But in roentgenologic practice tube voltage has proved unsatisfactory as a general method of specifying X-ray quality because of the variations in voltage wave forms, differences in X-ray tubes, differences in filtration, and difficulties in the reliable measurement of high voltages.

The field of optics supplies an excellent example of the specification of the quality of a heterogeneous beam of radiation by a single numerical value. The quality of the radiation emitted by an incandescent "black body" (a uniformly heated enclosure) is completely determined by the temperature. The quality of any other radiation which can be matched by the radiation from a

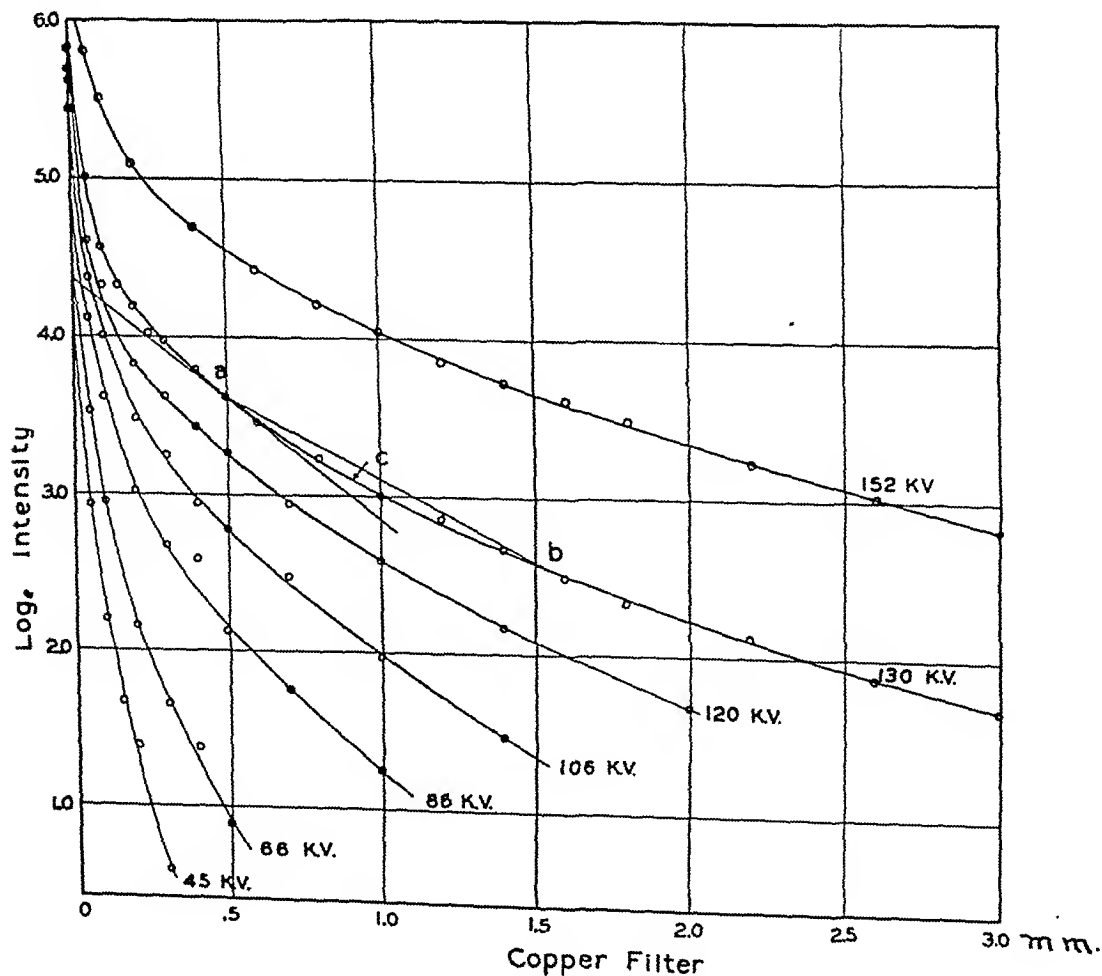


Fig. 1. Taylor's curves for the absorption of X-rays at various voltages in copper (1)

ON THE SPECIFICATION OF X-RAY QUALITY¹

By R. B. WILSEY, M.A., ROCHESTER, NEW YORK

INTRODUCTION

IN the measurement and specification of X-ray quality, simplicity is a very desirable feature; the use of tube voltage as an indirect method of hardness specification, and of such methods as penetrometer scale reading, half value layer, effective or average wave length, and absorption coefficient, based on observations made on the X-ray beam, all have the merit of expressing the quality by a single numerical value. Undoubtedly each of these methods has its sphere of usefulness. In the following discussion, however, reasons will be given for considering that none of them is adequate as a general specification of quality and that a single coefficient can hardly be expected to describe the quality of a heterogeneous beam of X-rays with sufficient exactness for all practical roentgenologic purposes. A method of quality specification is proposed which, it is believed, avoids the weaknesses of previous methods in that (1) it describes the quality of any X-ray beam used in roentgenologic practice with satisfactory completeness; (2) it involves but little more work in its measurement than do existing methods of X-ray quality specification; (3) more information of practical importance can be derived from this method than from other methods, and (4) the other principal methods of quality specification such as half value layer, effective wave length, absorption coefficient, and homogeneity coefficient can easily be derived from this method. The method, in brief, is to express the radiation quality simply by the relation between the transmission of the X-rays by a given filter material and the thickness of the filter.

Probably the most suitable way of ex-

pressing this relation is to plot the curve of $\log \frac{I}{I_0}$ against filter thickness, where I_0 is the intensity incident upon the filter, and I the intensity transmitted by the filter; $\frac{I}{I_0}$ is, therefore, the transmission. $\log \frac{I}{I_0}$ is equivalent to $\log I - \log I_0$, so that the curve of $\log I$ plotted against filter thickness is identical with that of $\log \frac{I}{I_0}$ against filter thickness except for a shift of the whole curve along the $\log I$ axis by an amount $\log I_0$. It is the form of this curve which describes the quality of the radiation; therefore, it is immaterial whether $\log I$ or $\log \frac{I}{I_0}$ is plotted against filter thickness as a specification of the radiation quality. In the following discussion this curve will be called the *absorption curve*. A group of such curves, of $\log I$ plotted against thickness of copper filter for various X-ray tube voltages (constant potential), are shown in Figure 1. These are taken from a recent paper by L. S. Taylor (1). This is a graphical, rather than a numerical, specification of quality; the interpretation is made ordinarily by visual inspection of the curve. Two or more curves can be compared, preferably by superimposing them, so that their similarities and differences can readily be noted. For instance, in the curves of Figure 1, the most obvious and significant difference among them is in the average slope of the curve, which varies with the tube voltage; other significant features are the degrees of curvature in different curves and the variation in curvature from one part of a curve to another. The data plotted in such curves may also be presented in tabulated form,

¹Presented before the Commission of Measures, Third International Congress of Radiology, Paris, July, 1931. Communication No. 480 from the Kodak Research Laboratories.

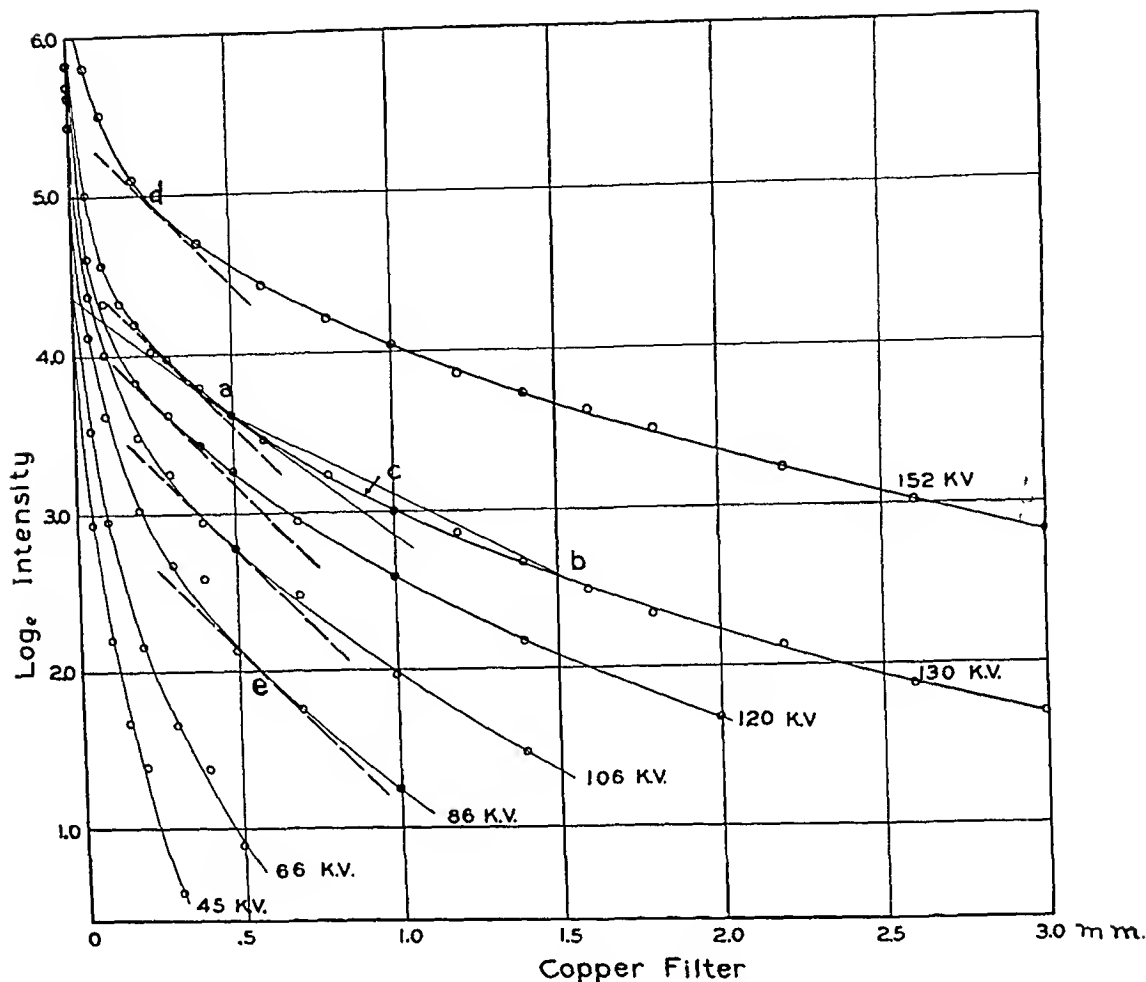


Fig. 3. Reproduction of curves of Figure 1, with tangents of slope 2.0 shown by dotted lines.

maximum and then gradually diminishes. Spectral lines may be superimposed upon the continuous spectrum, but the energy contributed by them is generally but a small part of the energy of the whole X-ray beam. These X-ray spectra are very simple compared to the variations occurring in optical spectra; consequently, greater simplicity in quality measurement and specification is possible, but it may well be questioned whether the extreme simplicity of a single numerical specification of quality can adequately define the various qualities of radiation used in common roentgenologic practice.

The property of X-rays which most read-

ily distinguishes different X-ray qualities is absorption, and the ease of absorption measurement, as compared with the difficulties of spectral intensity measurement, is responsible for the utilization of various absorption methods of measuring X-ray quality. The methods which have been given the most serious consideration—the half value layer, effective wave length, and absorption coefficient—are all essentially alike. Each depends on the measurement of the absorption of the X-rays by a single layer of material. These methods have recently been analyzed experimentally by Taylor (1), who shows how the variability of the results of such determinations is affected by

black body operated at a suitable temperature may be specified by the value of that temperature, called the "black body temperature" or the "color temperature" of the radiation. It is common practice to express the

specifying quality has been along lines of greater ease and rapidity of measurement rather than in simplicity of specification or definition.

In the case of X-rays, the routine deter-

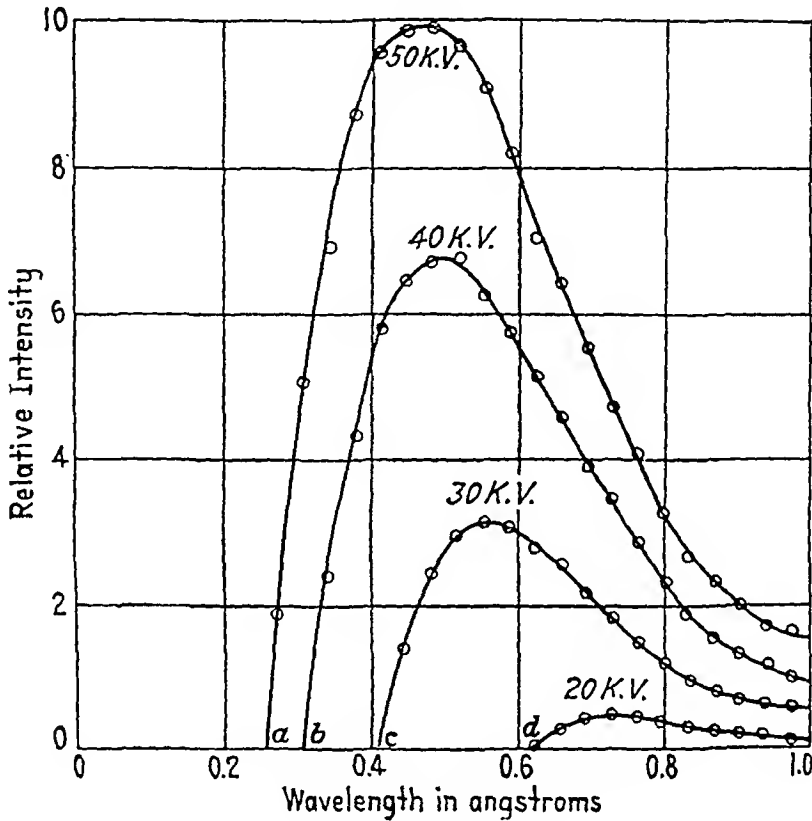


Fig. 2. Ulrey's curves for the spectral distribution of X-ray intensity (2).

color of the light emitted by incandescent solids in terms of color temperature; this temperature is not necessarily the temperature of the body emitting the light but represents merely the temperature at which a "black body" emits light of the same quality.

In general, color or radiation qualities in the field of optics cannot be defined so simply. For purposes of specifying the visual sensation value of a color two numerical values, in addition to the intensity factor, are necessary. For most purposes, the spectrophotometric curve of intensity is required. Improvement in the method of

mination of a spectrophotometric curve is impractical, but because of simplicities in the spectral composition of the X-rays used in roentgenology, such a procedure should not be necessary. Such X-rays consist of a continuous wave length band extending from a minimum wave length determined by the maximum voltage applied to the tube to a long wave length limit (not a sharp limit), determined principally by the filtration. Figure 2 shows some typical spectral intensity curves for X-rays obtained by Ulrey (2). Beginning at the minimum wave length, the intensity increases to a

the conditions of measurement, especially by the choice of filter thicknesses to be used in the determination of effective wave length. To eliminate this difficulty, and to refine the method, Taylor proposed that the absorption coefficient used in computing the effective wave length be determined from the slope of the tangent to the absorption curve at the filter thickness actually used to filter the X-ray beam. Assume the radiation whose quality is to be measured is that produced by 130 K.V., and filtered by 0.5 mm. of copper (Fig. 1); a tangent is drawn to the curve for 130 K.V. at the 0.5 mm. thickness value. The slope of the tangent at this point (α) gives the logarithmic loss of intensity with filter thickness and is equal to the (negative) absorption coefficient. This procedure is equivalent to the use of an infinitesimal thickness of filter for the determination of effective wave length, and, in theory, provides the ultimate refinement in the single filter method of deriving effective wave length.

In a mathematical analysis of methods of X-ray quality measurement, Schwarzschild (3) also shows that the slope of the absorption filter thickness curve is theoretically more exact than the use of a finite thickness of filter for the determination of effective wave length, and he derives the meaning of this slope or absorption coefficient in terms of the spectral intensity distribution in the X-ray beam.

From the curves in Figure 1, it may easily be shown that the same effective wave length values can be derived from various combinations of voltage and filtration. For instance, a tangent of slope 2.0 can be drawn to most of the curves in this chart, and the point at which the tangent touches each curve gives the combination of voltage and filtration producing this one value of absorption coefficient. This is demonstrated in Figure 3, where the curves of Figure 1 are reproduced, with the tangents of slope 2.0 drawn

in dotted lines. The voltage-filtration combinations are listed in the following tabulation.

TABLE I.—VOLTAGE-FILTRATION COMBINATIONS GIVING AN ABSORPTION COEFFICIENT OF 20 (IN COPPER), FROM THE CURVES OF FIGURE 3

K.V.	Thickness of copper filter
86	0.58
106	.43
120	.28
130	.31
152	.28

The effective wave length in this case is 0.23 Å., which means that monochromatic X-rays of this wave length would give a straight absorption curve of the same slope as the tangents drawn in Figure 3.

It has already been pointed out by Failla (4) that radiation quality cannot be specified by a single factor, and in proof of this statement he quotes experiments of Quimby, who obtained the same effective wave length with voltages varying from 125 K.V. to 200 K.V. by suitable choice of filter. Failla recommended that, in addition to effective wave length, the following factors be reported: general character of the high tension apparatus, the peak voltage applied to the tube, and the filter. It is preferable, however, to specify X-ray quality wholly in terms of measurements made on the X-ray beam, rather than to include data pertaining to the generating apparatus, provided this can be done in a satisfactory and practical way.

In specifying the quality of the radiation merely by its effective wave length, there would be no indication as to what combination of voltage and filtration produced the radiation. Perhaps it makes no difference what voltage and filtration were used as long as the effective wave length is the same. Evidence to this effect is reported by Hickey, Pohle, Lindsay, and Barnes (5), who found that two X-ray beams of equal

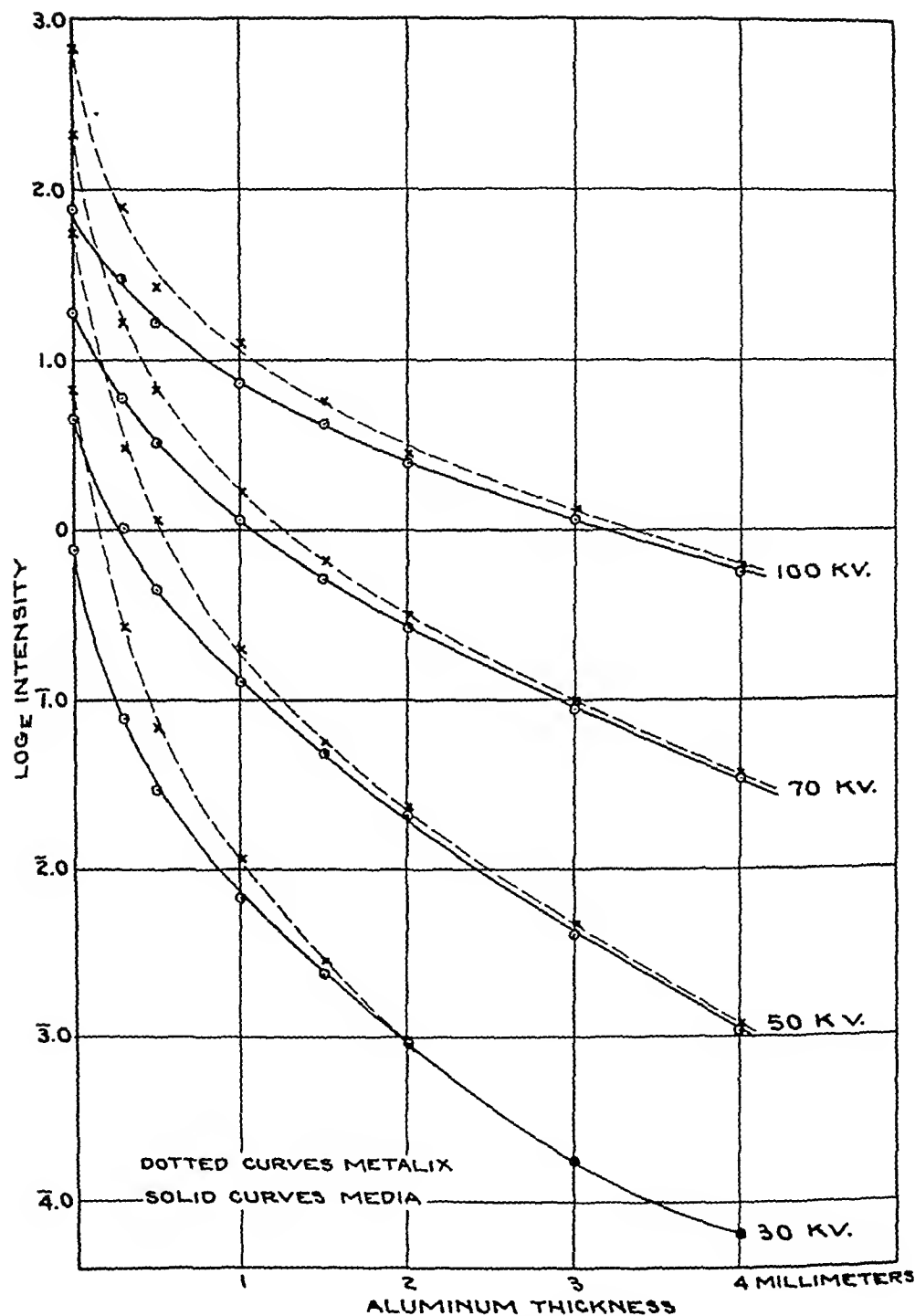


Fig. 4. Neeff's data on two diagnostic X-ray tubes plotted in the form of $\log I$ against aluminum filter thickness (7). These data apply to two particular X-ray tubes, and cannot be taken as generally characteristic of the types of tubes named.

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effective wave length, one produced by 80 K.V. and a filter of 0.2 mm. of copper, and the other by 180 K.V. and 1.0 mm. of aluminum, gave approximately the same skin dose and nearly the same depth dose in a water phantom. A similar observation is reported by Holthusen and Gollwitzer (6).

These two radiations, however, do not have the same spectral quality. Data are not available for the quantitative estimation of the differences in spectral quality, but the character of the difference is fairly obvious; the low voltage and high filtration produce a narrow wave length band, while the high voltage and low filtration produce a wide wave length band. If a large field is radiated under deep therapy conditions, X-ray scattering would do much to equalize the ratio of depth dose to skin dose for two radiations having the same effective wave length but different wave length spreads. In radiography with the Bucky diaphragm, however, the situation is quite different, and in the absence of definite proof it certainly would be unwise to assume that radiations of equal effective wave length would be equivalent radiographically, regardless of differences in the width of spectrum occupied by the radiation. That the penetration effects of two such wave length compositions, as *d* and *e* in Figure 3, are not the same in copper may be shown from the absorption curves of the two; the filtration of each by an additional half-millimeter of copper reduces the intensity of one to 43 per cent, and the other to 52 per cent, of the original value.

Furthermore, it has not yet been proved that the X-ray effects of principal interest in roentgenology—the biological and the photographic—are always the same for the same effective wave length values, regardless of the spectral composition. On the contrary, it would be a remarkable series of coincidences if such were the case. Evidence against such an assumption will be presented in later paragraphs.

The problem of distinguishing between wide and narrow wave length bands having the same effective wave length has been solved theoretically by Schwarzschild (3). He defines a homogeneity coefficient, derived from absorption data, which is a measure of the effective wave length spread of the X-ray beam. It would appear that the combination of effective wave length and homogeneity coefficient would constitute an adequate description of X-ray quality for most purposes; however, as will be shown later, such is not always the case. Furthermore, its determination is rather a laborious procedure, since it involves plotting the derivative of the absorption curve and finding the slope of this derivative at the thickness of filter by which the beam to be described has been filtered. The point is that slope determinations lead to greater irregularities in the specification of X-ray quality than does the use of the absorption curve from which the slopes have been derived.

THE ABSORPTION CURVE AS A QUALITY SPECIFICATION

Schwarzschild states that it may be shown mathematically that only one spectral intensity distribution can be associated with any given absorption curve, so that this curve uniquely defines the spectral intensity distribution. Since the spectral absorption of the common filter materials, copper and aluminum, is more selective than that of tissue, the use of such filters in this method will discriminate more sensitively between the penetrating properties of radiation than is necessary for roentgenologic purposes. Whether this method of quality specification is sufficiently sensitive to differentiate between qualities producing observable differences in biological and photographic effects cannot be stated definitely from the evidence available at present. In view, however, of the uncertainties in the measurements of biological and photographic effects, as com-

pared with the precision of ionization measurements of X-rays, it is highly probable that the absorption curve is amply precise for distinguishing radiations having measurable differences in biological or photographic action.

From these considerations it appears that the absorption curve has all the necessary properties as a specification of X-ray quality, and has many advantages over other methods. It provides a unique description of the radiation quality; it is a simple form of expression recording experimental data without any complicated calculation; the principal facts about the characteristics of the radiation may be derived by simple inspection of the curve; it appears to be sufficiently precise for roentgenologic applications; other absorption specifications of radiation quality can be derived from this method, and further investigations are likely to bring out additional interpretative values of such a curve.

For the higher voltage X-rays such as are used in deep therapy, copper is obviously the most suitable filter material, while the quality of diagnostic X-rays might best be expressed by the use of aluminum filtration. It would be a simple matter from the spectral absorption data on these two metals to derive a method of converting an absorption curve for one of these metals to the equivalent absorption curve of the other for the same radiation. It may be advisable, however, for the sake of convenience, to agree on a definite range of qualities to be specified with aluminum filtration and another range with copper filtration.

QUALITY SPECIFICATION OF DIAGNOSTIC X-RAYS—STUDY OF EXPERIMENTAL DATA

The principal value of the complete absorption curve as a specification of X-ray quality will occur in its application to the ra-

dations used in roentgen diagnosis and superficial therapy. A discussion of the problem of quality specification in these fields follows.

At diagnostic voltages especially, variations in the thickness of glass, and perhaps other factors, in X-ray tubes may cause considerable variations in the intensity and quality of the X-ray output. Occasionally diagnostic tubes are encountered which have an unusually high output of unfiltered rays, while the photographic or fluoroscopic effect through thicker portions of the human body may be but little above the average. Examples of this have recently been reported by Neeff (7) and by Ratti (8). Neeff gives ionization measurements of the X-ray output of two diagnostic tubes at various voltages through various thicknesses of aluminum filter. Figure 4 shows Neeff's data plotted in the form of log *I*-aluminum thickness curves; the dotted curves apply to the Metalix tube and the solid lines to the Media tube. These curves are undoubtedly characteristic of the individual tubes, and cannot be considered applicable to all tubes to which these names are given.

TABLE II.—NEEFF'S DATA (7) ON TWO X-RAY TUBES AT 70 K.V.

Filter mm. Al	r/min. (in air) for 1 ma. and 50 cm. distance		Ratio Metalix/Media
	Media	Metalix	
0.0	3.57	10.20	2.86
.3	2.19	3.37	1.54
.5	1.68	2.28	1.36
1.0	1.06	1.24	1.17
1.5	0.75	.834	1.11
2.0	.561	.602	1.07
3.0	.348	.359	1.03
4.0	.230	.238	1.03

Table II gives the ionization readings on the two tubes at 70 K.V.; without filter, the Metalix tube has nearly three times the output of the Media tube, while through 4 millimeters of aluminum the difference in the output of the two tubes is about 3 per cent,

effective wave length, one produced by 80 K.V. and a filter of 0.2 mm. of copper, and the other by 180 K.V. and 1.0 mm. of aluminum, gave approximately the same skin dose and nearly the same depth dose in a water phantom. A similar observation is reported by Holthusen and Gollwitzer (6).

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Column 5 in Table III gives the homogeneity coefficients of the radiations listed. It is to be noted that the homogeneity coefficients for radiations 3, 4, and 5 are the same within the errors of their determination. Thus the combination of absorption coefficient and homogeneity coefficient fails to distinguish between the qualities of the radiation of the Media and Metalix tubes at 50 K.V., with 0.32 mm. aluminum and 0.69 mm. aluminum filtration, respectively, and also fails to distinguish between these qualities and the quality of the Media tube at 70 K.V. and 0.18 mm. Al filter. Remembering that the absorption coefficients are the same for all the radiations listed in Table III, it would be expected that the homogeneity coefficients would show some systematic change with voltage on each tube, or with change of tube at the same voltage; however, these variations are rather erratic. The homogeneity coefficient is derived from the rate of change of the slope of the absorption curve, and under the conditions listed in Table III these slopes were changing rather rapidly. It was apparent to the writer, in determining these values, that they could be affected materially by errors of observation or slight variations in the way in which the curves are drawn through the points, as well as by the difficulties of accurate slope measurement. In fact, homogeneity coefficient is doubly affected by the various sources of error occurring in the determination of slope, since it requires a series of slope measurements on the absorption curve, from which a curve of slope plotted against filter thickness is drawn, and an additional slope measured on the latter curve. Under some conditions, the homogeneity coefficient may provide, with the absorption coefficient, a sufficiently definite specification of the radiation quality, but the above examples show that cases can readily arise in which it is inadequate for that purpose.

As for the absorption curves of Figure 4, no two of them are alike; there is no possi-

ble danger of one being confused with another. There are characteristic, systematic differences between the two tubes, and definite regular differences in passing from one voltage to another. Furthermore, it is not possible, by a variation of the voltage on one tube, to make its absorption curve agree with that of any one voltage on the other tube. Figure 5 shows a comparison of the curve for the Metalix tube at 77 K.V. (obtained by interpolation) with the Media curve at 70 kilovolts. These were adjusted to make the average slope of the curves the same between 1 and 4 mm. of aluminum, and the positions of curves are adjusted vertically to make them intersect at those filtration values. These curves do not differ much between 1 and 4 mm. of aluminum, but the difference is observable, and is still more marked at filtrations of less than one millimeter.

For radiographic purposes, the absorption curves should be determined for thicknesses of aluminum filter as high as 10 millimeters. It is apparent that at each voltage the curves (Fig. 4) of the two tubes become more nearly alike as filtration increases, so that for filtrations exceeding 2 mm. the radiation quality given by the two tubes is practically identical. Therefore, for the radiography of tissue thicknesses of filtration value greater than the equivalent of 2 mm. of aluminum, the quality of one tube can be matched by that of the other by operating them at equal or nearly equal voltages. For radiography of thin layers of tissue, the two tubes differ very appreciably in the intensity and absorbability of the radiation. It appears possible that for a narrow range of filtrations the operation of the two tubes, each at a suitable voltage, could result in effectively the same quality. But the complete absorption curve is required to tell the whole story, showing both the similarities and the differences in the different samples of radiation.

It was also found that the slopes of the

which is doubtless less than the errors of measurement. Beyond 2 millimeters filtration, the curves for the two tubes run nearly parallel, showing but little difference in tube output. It may be concluded that for the radiography of body parts the filtration of which exceeds the equivalent of 2 mm. Al, the two tubes are practically identical, while the skin dose (assuming the tubes are used without filtration) would be nearly three times as great with the Metalix tube as with the Media tube. The absorption coefficient of the unfiltered radiation from these tubes would indicate a considerable quality difference, yet the two tubes are equivalent for diagnostic purposes for most body parts. The absorption curves, however, describe the true state of affairs at a glance, showing both the radiographic equivalence of the tubes, and the difference in skin dose without filtration.

With the curves of Figure 4, as with those of Figure 3, it is possible to select a point on each curve corresponding to a single value of absorption coefficient. Table III gives the values of voltage and filtration on the various curves, for which the absorption coefficient has the value 16.5.

The aluminum filter thicknesses in Table III are all less than one millimeter. The use of absorption coefficient alone as a specification of quality leads to the conclusion that the quality of 30 K.V. radiation could be made equal to that of 100 K.V. radiation by a change in filtration of only a fraction of a millimeter of aluminum. In the light of practical experience, this conclusion is absurd; in fact, radiography of thick body parts at 30 K.V. is wholly impractical. There would be a very large difference in radiographic contrast produced by 30 K.V. and 100 K.V. radiations, and certainly this contrast difference would not be affected to any great extent by the slight changes in filtration required to equalize the absorption coefficients of the two radiations.

TABLE III.—VOLTAGE-FILTRATION COMBINATIONS GIVING AN ABSORPTION COEFFICIENT IN ALUMINUM OF 16.5, OR AN EFFECTIVE WAVE LENGTH OF 0.74 ÅNGSTRÖM (FROM DATA OF NEEFF, 7)

	Tube	K.V.	Filter mm. Al	r/min. for 1 ma. at 50 cm.	Homogeneity coefficient
1.	Media	30	0.5	0.216	0.632
2.	Metalix	30	.76	.197	.595
3.	Media	50	.32	.993	.617
4.	Metalix	50	.69	.730	.609
5.	Media	70	.18	2.59	.616
6.	Metalix	70	.48	2.39	.653
7.	Media	100	.10	5.47	.669
8.	Metalix	100	.39	5.37	.663

If all the radiations listed in Table III have equivalent quality, then any given radiographic exposure should require the same number of roentgens of exposure with each of them. For instance, at 100 K.V. and 0.10 mm. aluminum filter, the output of Media tube measured in roentgens per minute is 5.5 times that at 50 K.V. and 0.32 mm. aluminum filter, so that on this basis the lower voltage should require 5.5 times as many milliampere-seconds as the higher voltage to produce the same radiographic effect. Neeff does not report on the comparative radiographic effectiveness of these two radiations, but experiments in our laboratory show that body parts of medium tissue thickness, such as a chest radiographed with double screens, require about twenty-five times as much exposure at 50 K.V. as at 100 kilovolts. While it is not strictly fair to compare ionization measurements on one X-ray machine with radiographic tests on another, it is unlikely that the large discrepancy between the ionization ratio and the radiographic ratio of 50 K.V. and 100 K.V. radiations is due to the differences in the X-ray machines. It is fairly obvious then, that absorption coefficient, or effective wave length, alone is grossly inadequate as quality specification for radiographic purposes.

intensity and quality measurements; an excellent example is given by Pohle and Wright (9), who have compared the X-ray output of two X-ray machines by means of the absorption curves ($\log I$ —filter thick-

absorption curve, especially over the greater filter thicknesses, and from the set of curves for the X-ray generator to find at which voltage a curve is produced having about the same average slope in the range of heavier

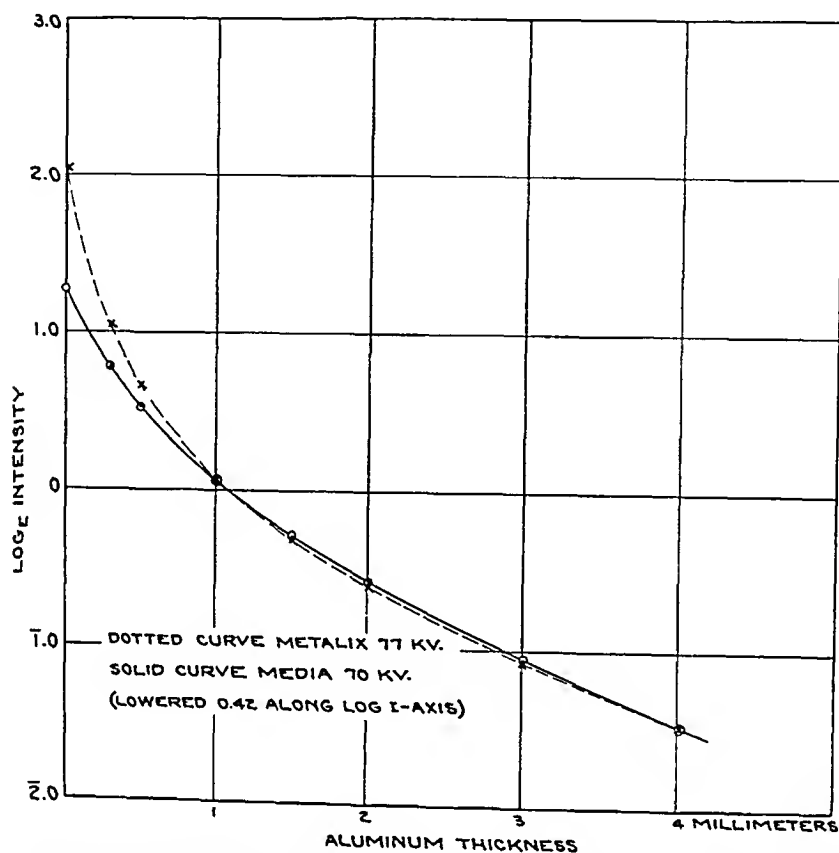


Fig. 5. Comparison of Metalix absorption curve at 77 K.V. with the Media absorption curve at 70 K.V. (from Neeff's data).

ness) obtained from each at various voltages. In the writer's opinion, there is no better way of describing the output of an X-ray generating apparatus.

In order to make routine use of this method of quality specification, the absorption curves of the X-rays produced by any X-ray generator should be obtained for the whole range of useful operating conditions. Then suppose it is desired to duplicate the radiation represented by an absorption curve provided by some other observer. The first step is to note the general slope of the given

filtrations. It may be necessary to interpolate between curves to find the voltage giving most accurately the desired value of this slope. If the radiation is to be used in the radiography of a thick part of the body, then so far as the radiographic result is concerned, it is the form and slope of the curve only for the greater filter thicknesses that need to be taken into account, and the same is true for heavily filtered high voltage radiation for deep therapy. If it is a question of superficial therapy with unfiltered radiation, then the whole absorption curve should

absorption curves of Figure 4 were difficult to determine reliably at very low filtrations, and rather erratic results were obtained, owing largely to irregularities in the experimental data. In the region of low filtrations, if a single thickness method of finding absorption coefficient is to be used, much more consistent results are obtained by the use of a finite thickness of filter than by the slope method.

It may be mentioned here that the slope measurements in this investigation were made with a semi-transparent mirror; at the point on the curve where slope is to be measured, the mirror is set at right-angles to the curve, as judged by the optical superposition of reflected and transmitted segments of the curve near the point of measurement.

INTERPRETATION AND USE OF THE ABSORPTION CURVE

Certain features of absorption curves may be interpreted quite readily. The steeper the slope, the softer and more absorbable is the radiation. The curves of both Figure 1 and Figure 4 show how the average slope of the absorption curve, and especially the slope in the more heavily filtered portion, decreases systematically with increase in tube voltage. Monochromatic X-rays give a truly straight absorption curve; and the degree to which the absorption curve approximates a straight line is a measure of the homogeneity of the radiation. The fact that at any one voltage the curves of the Media and Metalix tubes of Figure 4 have nearly equal slopes at the heavier filtrations indicates that the harder components of the radiation from the two tubes are similar, whereas the greater curvature of the Metalix curves at the lower filter thicknesses show that its softer component is less homogeneous than that of the Media tube, and that the Metalix tube emits a greater proportion of soft radiation than the Media

tube. These conclusions may be derived from inspection of the forms of the curves alone, without any knowledge of the voltages associated with the curves or the relative positions of the curves along the log I axis.

The close similarity in the wave length variation of absorption of X-rays by different materials makes it possible to derive simple relationships between the X-ray absorbing characteristics of different materials. For instance, 1 cm. of aluminum and 15 cm. of water have equal filtration values, that is, each one transmits the various X-ray wave lengths in the same relative intensities; while these two filters transmit the same quality of radiation (assuming equal incident quality) they do not transmit the same intensity, as the 1 cm. of aluminum transmits about 2.5 times the intensity transmitted by the 15 cm. of water. Thus from information of this sort, computed from well known spectral absorption data, it is a simple matter to derive the absorption characteristics of primary X-rays in one substance from a knowledge of their absorption in another, so that the absorption curve in copper or aluminum may be used to obtain information about the absorption of the same radiation in water or tissue. In large volumes of water or tissue, scattering affects the total X-ray intensity at any point very considerably. The scattering of X-rays in water phantoms has been investigated under a great variety of conditions so that such data, together with the absorption data, should make it readily possible to compute the total intensity distribution of any beam of X-rays in a volume of water, provided the quality of the incident beam is expressed by its absorption curve. Much more research will doubtless be necessary, however, to realize the full usefulness of the absorption curve in its application to the absorption of X-rays in body tissues.

The absorption curve is already used to some extent in reporting results of X-ray

by any single measurable factor, nor are they sufficiently uniform in character to be described by a single numerical specification.

It is shown from experimental data that the same effective wave length, or absorption coefficient, can be produced by a wide range of combinations of tube voltage and filtration, and that the corresponding radiations are not equivalent in their absorption and photographic effects.

The use of a homogeneity coefficient (derived from absorption data) in addition to the absorption coefficient, defines radiation quality more completely than the absorption coefficient alone, but its determination is rather involved for routine purposes; furthermore, any coefficients dependent upon slope measurements are subject to considerable error both in the measurement of slope and in the ways in which slope is influenced by errors in experimental data and personal judgment in fitting the curve to the data.

Absorption and homogeneity coefficients derived from experimental absorption curves ($\log I$ plotted against filter thickness) were found less capable of distinguishing between different radiation qualities than the absorption curves themselves.

The absorption curve ($\log I$ or $\log \frac{I}{I_0}$ plotted against filter thickness) is proposed as a general specification of X-ray quality for the following reasons: (1) It is uniquely related to the spectral distribution

of X-ray intensity; (2) it discriminates more accurately between different qualities of X-rays than other methods of quality specification; (3) it is certainly adequate to distinguish radiations having appreciably different absorption in tissue, and probably is amply precise for the distinction of quality variations which show measurable differences in biological or photographic effects; (4) it is a simple form of expression, avoiding complicated calculations; (5) the principal characteristics of the radiation can be interpreted readily by inspection of the curve; (6) other methods of X-ray quality specification, such as half value layer, absorption coefficient or effective wave length, and homogeneity coefficient may be derived from the absorption curve, (7) and further experience and research will make possible the derivation of additional information of value from such a curve.

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be matched as closely as possible. The selection of tube voltage will generally be governed by the average slope of the high filtration portion of the curve, while the duplication of the low filtration portion of the curve is apt to depend on the proper selection of the X-ray tube.

An unusually high output of soft radiation by a radiographic tube will indicate the necessity of filtration to avoid an excessive skin dose; usually 1 mm. thickness of aluminum will be sufficient in such a case. In fact, it is an excellent precaution always to use such a filter over a radiographic tube, as the effect of the filter upon radiographic exposure is slight, while the reduction in skin dose is considerable, especially with some tubes.

Of course, a certain amount of practical experience will need to be obtained with absorption curves in order to interpret them most intelligently, so as to be able to tell what sort of variations in the curve indicate effects due to the characteristics of the X-ray tube, or to the voltage wave form, and what forms are normal, and what are abnormal.

The correlation of the quality of the radiation with its biologic and radiographic effects should be much more systematic and intelligible by this quality specification than by other methods. Its advantages should be especially marked in superficial therapy, where little or no filtration is used, since in this case there may be large variations in the quality emitted by different X-ray tubes, and the accuracy of measuring this quality by the slope methods is very poor.

Another advantage of the absorption curve is that it offers the possibility of deriving quantitative information on the spectral distribution of X-ray intensity. Schwarzschild has shown the significance of the absorption curve in terms of the spectral intensity distribution, and Dr. L. Silberstein has recently worked out a practicable method of deriving the distribution of in-

tensity in various sections of the spectrum from the absorption curve,² thus making it possible to draw an approximate spectral intensity curve.

In the foregoing discussion it is understood that all X-ray intensities are to be measured in standard roentgens per unit of time. In order to obtain the absorption curves for quality specification it is necessary to have an instrument which will permit correct values of roentgens per minute to be determined over the necessary range of voltages and filtrations. A standard chamber is hardly suited for routine measurements in a roentgenologic laboratory, and the readings of secondary chambers are apt to deviate considerably from the standard chamber as the X-ray quality changes; this is especially true of instruments employing thimble type chambers. There is a genuine need for an X-ray measuring device which is simple, rugged, portable, easily read, and the indications of which can be translated into standard roentgens with but simple forms of correction for all useful qualities of X-rays. Some such instrument will be necessary if the measurement of X-ray intensities and the standardization and control of X-ray technic by such measurements is to become common practice in roentgenologic work. With this instrument the determination of the absorption curve would be a simple matter and could be carried out nearly as easily and as quickly as a reliable sphere gap measurement of voltage; in fact, it is quite possible that the calibration of X-ray generators by absorption curves would render measurement of tube voltage unnecessary.

SUMMARY

While the spectral intensity distributions of the various qualities of X-rays used in roentgenologic practice are of relatively simple type, they are not determined uniquely

²Not yet published.

happened the voltage was immediately decreased for a quarter or half an hour, until the tube would operate smoothly. After this procedure the voltage could be again in-

withstand voltages as high as 400 kilovolts. A tube once treated in this manner could afterwards be used with full voltage without another preliminary treatment.

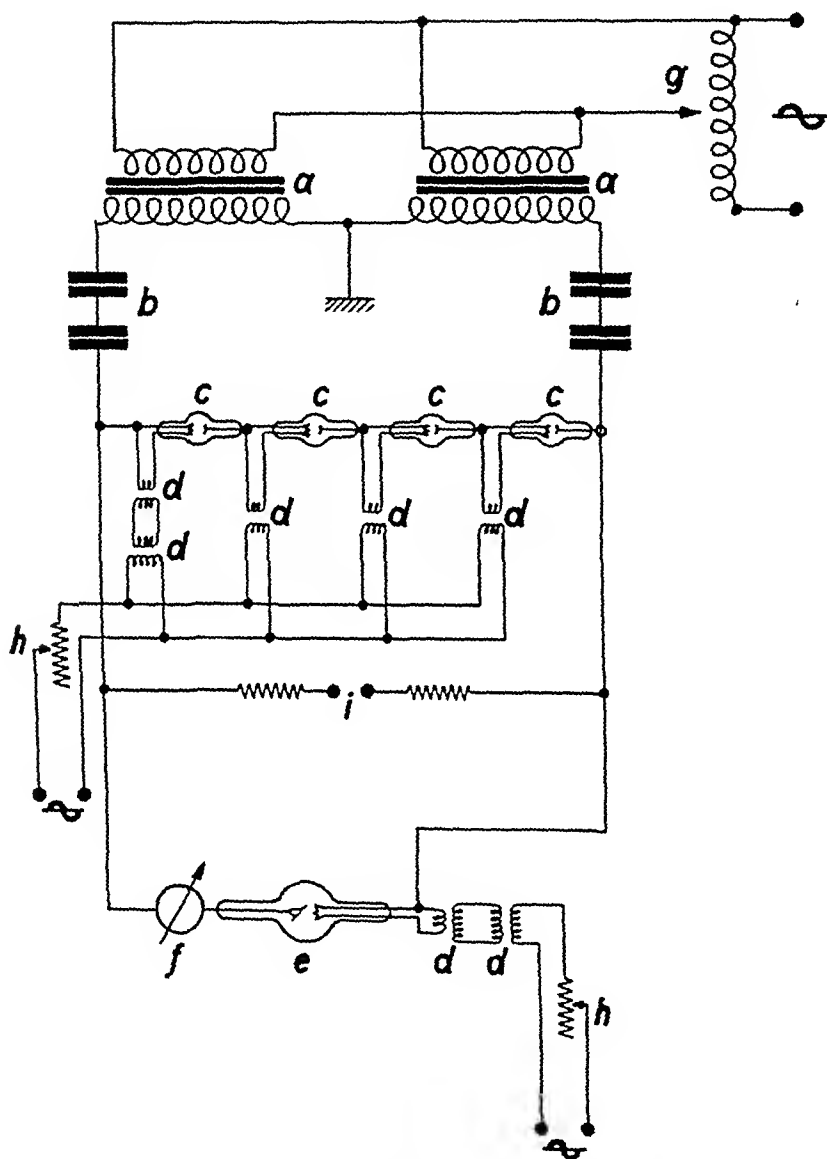


Fig. 3. Complete circuit of the roentgen apparatus: (a) high tension transformers; (b) condensers; (c) therapy rectifiers; (d) filament transformers; (e) roentgen tube; (f) milliammeter; (g) autotransformer; (h) resistances; (i) sphere gap (50 cm. diam.).

creased and the irregularity of the tube would disappear so that the voltage could be increased still more. Thus the tubes at our disposal could be gradually made to

It was possible to use a current of 0.5 ma. at 400 K.V., but if the current was increased the tubes became very irregular, probably because of the increased charge of

MEASUREMENTS OF EXTREMELY HARD ROENTGEN RAYS

By H. HERRMANN, PH.D., and R. JAEGER, PH.D., BERLIN, GERMANY

Translated into English by OTTO GLASSER, PH.D., Cleveland Clinic, CLEVELAND, OHIO

IT seems to be desirable from many physical and medical standpoints to be able to increase beyond the present limits the voltage which may be employed in roentgen therapy. This development is

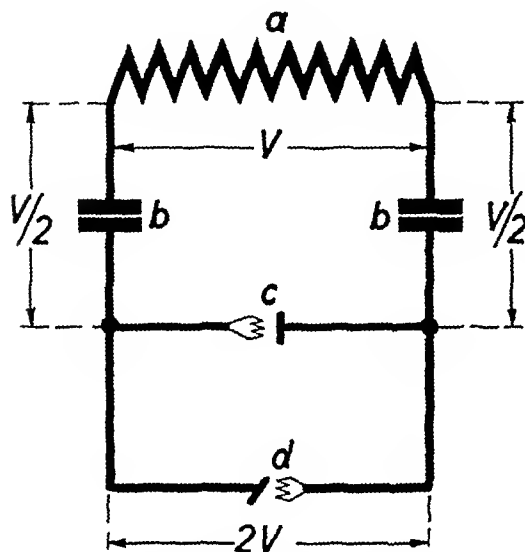


Fig. 1. Villard circuit: (a) transformer; (b) condensers; (c) rectifier tube; (d) roentgen tube.

given special encouragement because of the favorable results which have been obtained by the method of Coutard. Therefore, we wish to describe a roentgen apparatus which will generate voltages up to 400 K.V. and to present some measurements which were made of the radiation produced by it. This apparatus was developed in the laboratory of the Elektrizitäts-Gesellschaft Sanitas, of Berlin. The measurements were made in this same laboratory with instruments of the Physikalisch-Technische Reichsanstalt.

The circuit of this high tension apparatus has the Villard connection (1), the principle of which is illustrated by Figure 1. This

circuit produces a pulsating, unidirectional current of sine wave form, as illustrated by Figure 2. The Villard circuit is especially suitable for this work because the high tension curve always returns to zero; then the

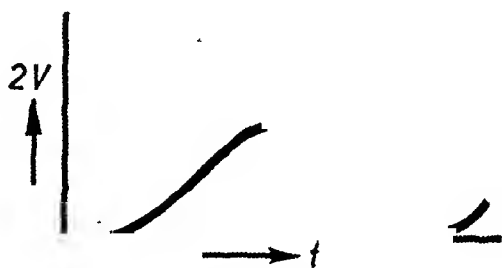


Fig. 2. Tension curve of the Villard circuit.

roentgen tube carries no load and any ionization which may occur in the tube is interrupted. Also, the self-induction in the secondary of the transformer tends to prevent any sudden increase of the tube current in case gas should be suddenly released in the tube. This conforms with numerous experiences in deep therapy in regard to the limit of potential which may be used, as it affects the life of tubes.

A schematic diagram of the apparatus is presented in Figure 3; Figure 4 shows the installation, at the Charity Hospital in Berlin, of a high tension generator which develops up to 600 kilovolts. The tubes are AEG therapy Type 3 (hard glass). It was learned that most of them could withstand up to 290 kilovolts. The voltage determinations were made by means of a 50 cm. sphere gap. It was found that if the voltage was increased beyond 290 K.V., a sudden "shock" occurred in the tube which was indicated by a coincident fluctuation of the pointer of the milliammeter. When this

happened the voltage was immediately decreased for a quarter or half an hour, until the tube would operate smoothly. After this procedure the voltage could be again in-

withstand voltages as high as 400 kilovolts. A tube once treated in this manner could afterwards be used with full voltage without another preliminary treatment.

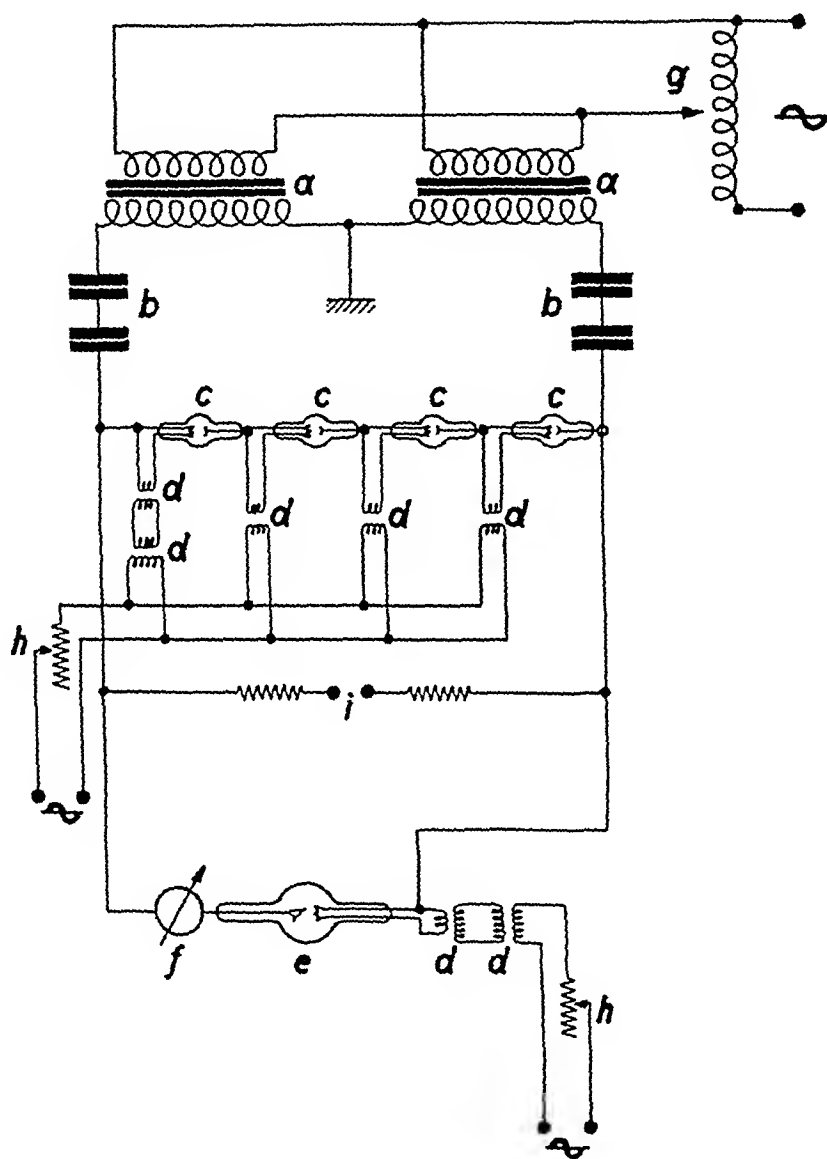


Fig. 3. Complete circuit of the roentgen apparatus: (a) high tension transformers; (b) condensers; (c) therapy rectifiers; (d) filament transformers; (e) roentgen tube; (f) milliammeter; (g) autotransformer; (h) resistances; (i) sphere gap (50 cm. diam.).

creased and the irregularity of the tube would disappear so that the voltage could be increased still more. Thus the tubes at our disposal could be gradually made to

It was possible to use a current of 0.5 ma. at 400 K.V., but if the current was increased the tubes became very irregular, probably because of the increased charge of

secondary electrons on the walls of the tube; however, at 400 K.V. and 0.5 ma., the tubes could be operated steadily and continuously

in addition to the indication of the peak voltage and filtration. We measured the half value layer in copper because this method is



Fig 4 Deep therapy apparatus for 600 K V "Gammavolt" of the "Elektizitäts Gesellschaft Sanitas," Berlin

One of our tubes has now been used for 100 hours without deterioration.

The radiation output at 400 K.V. and 0.5 ma corresponds to that used in the usual treatment conditions at 200 K.V. and 4 ma. so that it will be just as economical. We may also anticipate that roentgen tubes will be improved in the near future so that higher potential and more current may be employed.

A series of experiments were made in order to investigate the character of the extremely hard roentgen rays which are produced under these new conditions.

HALF VALUE LAYERS

Measurements of the half value layer were made because this is a practical method of determining the quality of radiation in

generally used in deep roentgen therapy to determine quality. The measurements were carried out with a dosimeter equipped with a small ionization chamber and a uranium standard, the same type which was used by H. Behnken (2) in his determinations of the protective qualities of the metal tube. It is possible to determine 10^{-6} r per minute with this dosimeter. The sensitivity of the instrument was determined by a special condenser. Two identical condensers, the plates of one of which were covered with uranium oxide, were arranged so that they could be alternately connected or disconnected with the instrument, therefore, the total capacity of the measuring apparatus, with or without the uranium standard, remained unchanged. The ionization chamber of the dosimeter was independent of the wave length for hard roentgen rays. Figure 5

shows the calibration constant of the chambers. It is permissible both from a theoretical and a practical point of view to to extrapolate the curve to the hardness of radio-active radiations.

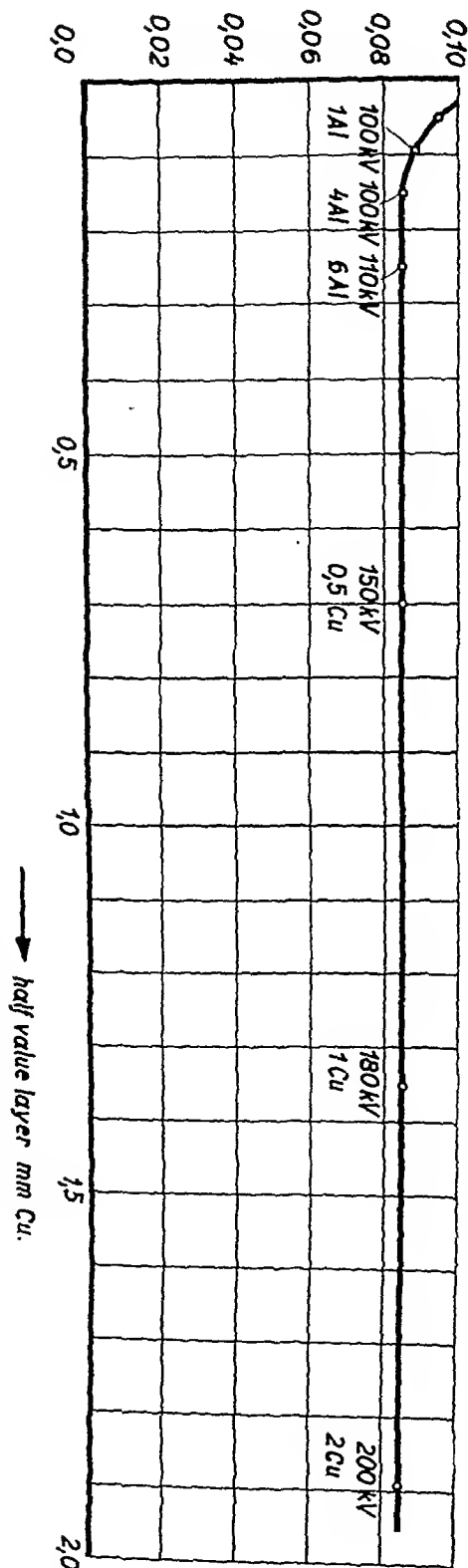
Figure 6 shows the relative position of the measuring instrument to the roentgen apparatus. The results of the measurement of the half value layer are illustrated in Figure 7. In order to control the measurements made with the sphere gap we have recorded the relationship of the radiation through 1 mm. of copper with the potential, and this relationship is explained by the curve of Figure 8. As may be expected, the curve shows that the hardness of radiation increases with the third power of the peak voltage. We find, for example, on the curve that at 400 K.V. and 0.5 ma. the intensity is the same as for 200 K.V. and 4 milliamperes.

DETERMINATION OF THE ABSORPTION IN LEAD

It is of special interest to compare the penetration of the roentgen rays which are produced at 400 K.V. with the radiation of radio-active substances. To make this investigation we carried out absorption measurements in lead because gamma radiation is usually indicated by its coefficients of absorption in lead.

The ionization chamber used in these determinations was placed in a lead container which had only one opening directed toward the roentgen tube. The results of these absorption measurements are illustrated by Figure 9, including the absorption curves at 204, 305, and 408 kilovolts, when the beams of radiation were filtered through 1 mm. copper plus 1 mm. aluminum. The curves show that for these qualities of radiation we can not determine an absolute coefficient of absorption for lead even through several millimeters. In order

Fig. 5. Dependence of the calibration constant k of the dosimeter upon the radiation quality $r/\text{sec.} = \frac{k \cdot \text{milligram seconds}}{\text{roentgen seconds}}$.



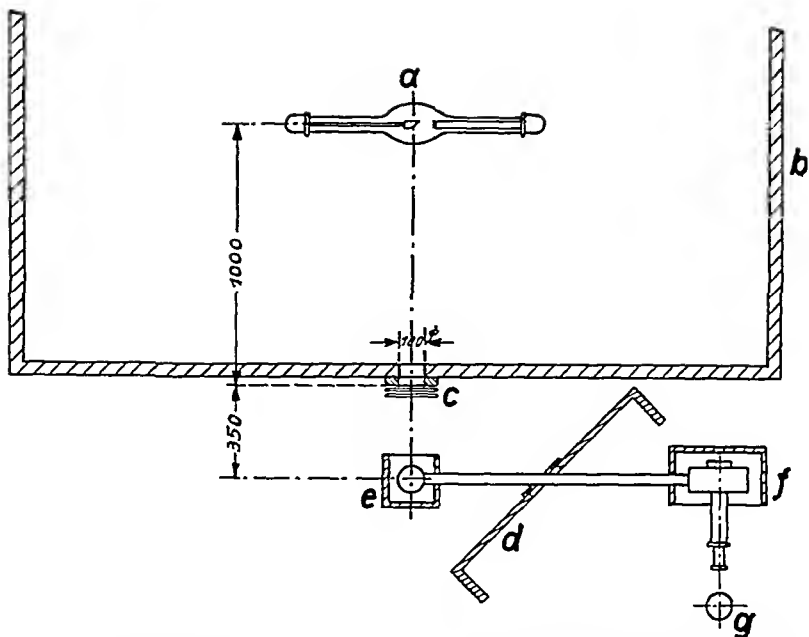


Fig. 6. Arrangement for the measurement of the intensity: (a) roentgen tube; (b) lead drum; (c) diaphragm and filter; (d) lead screen; (e) ionization chamber; (f) dosimeter; (g) observer.

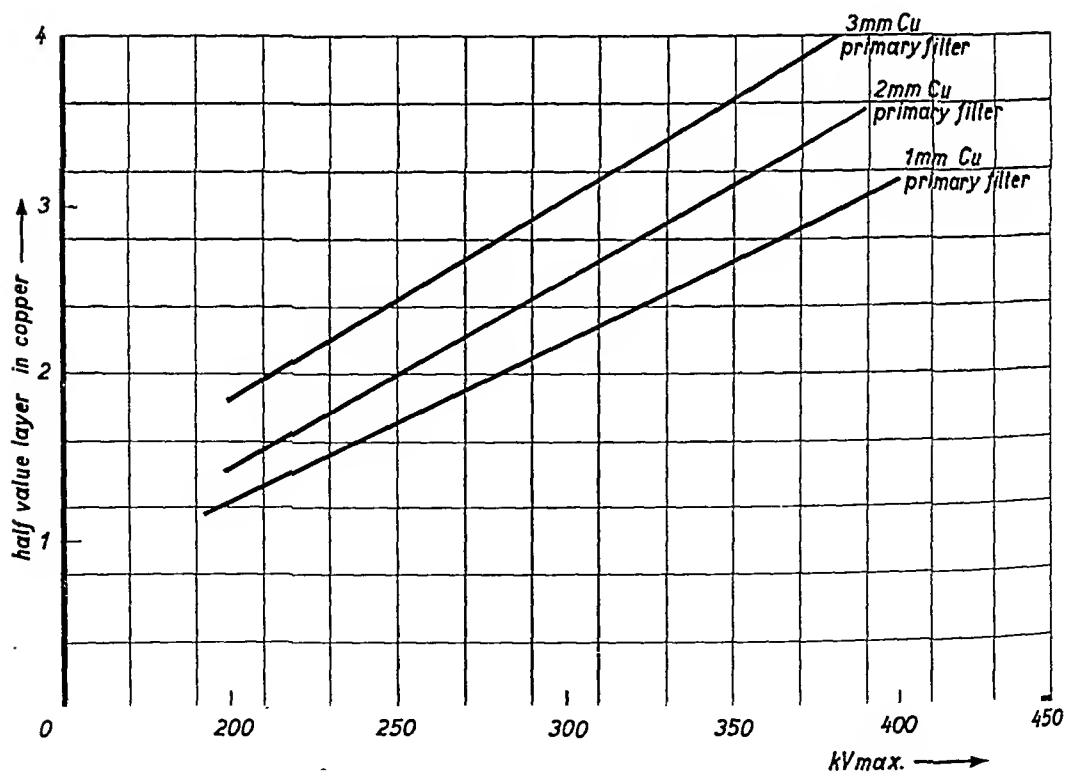


Fig. 7. Half value layers in copper.

to obtain a better idea of the change which occurs by increasing thicknesses of lead, we attempted to determine the coefficients of weakening for every half-millimeter of lead, and these results were noted in relation to the thickness of lead employed. As can be

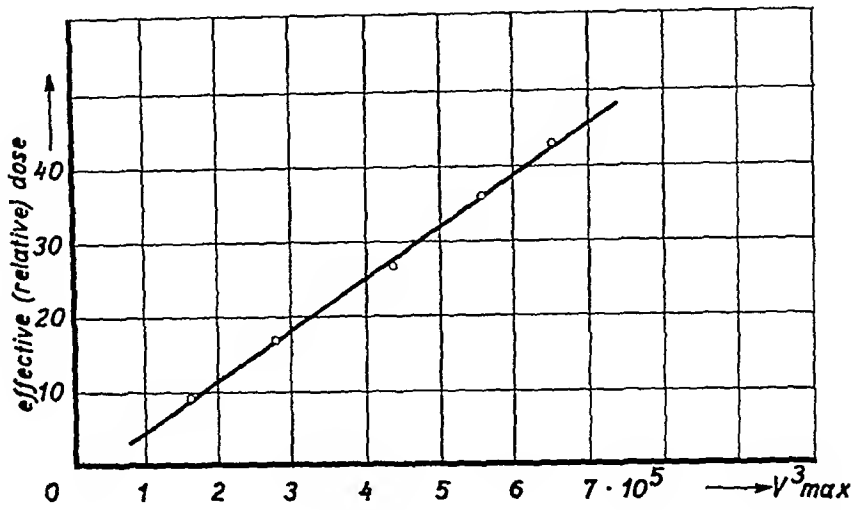


Fig. 8. Dependence of the effective (relative) dose upon the third power of the peak voltage.

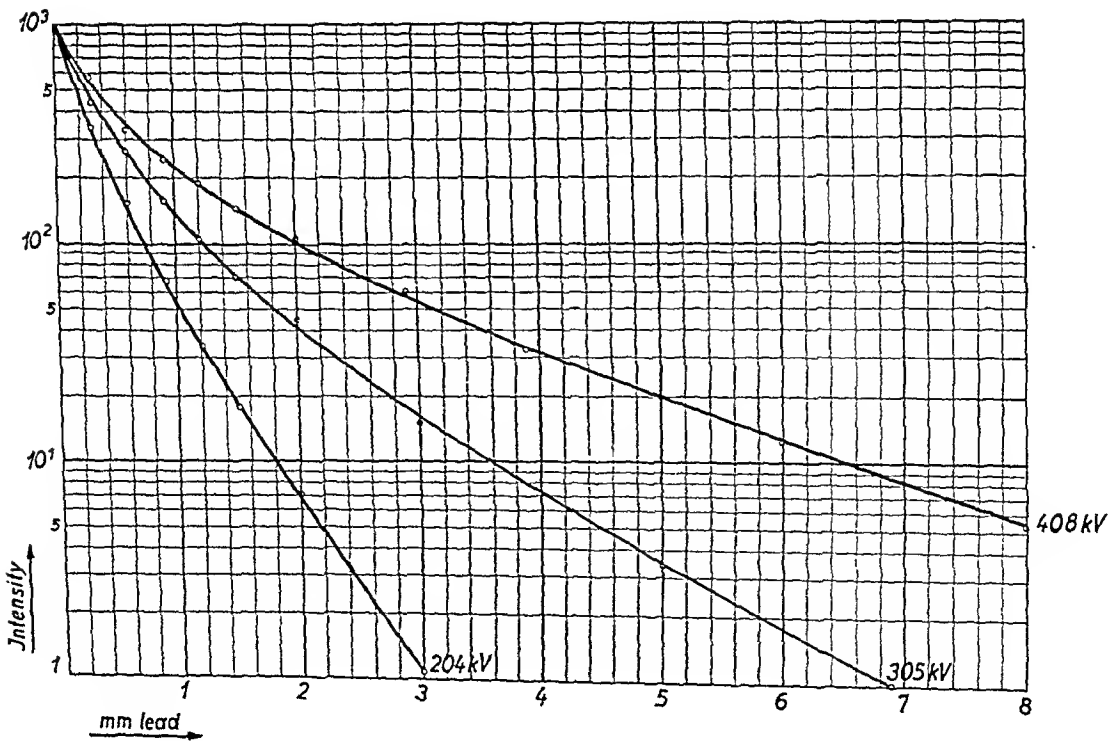


Fig. 9. Absorption curves in lead. Primary filter: 1 mm. Cu + 1 mm. Al.

seen from Figure 10, the differential curves of weakening in lead did not show a final value, at least for 300 or 400 kilovolts.

These results were compared with the values given by Glocker and Reuss for the coefficients of weakening through 3 and 4 mm.

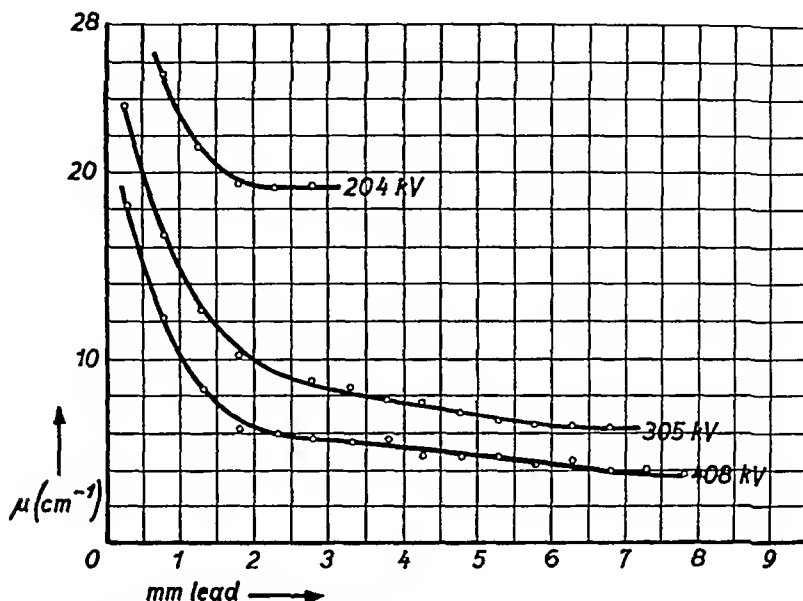


Fig. 10. Coefficient of weakening (cm^{-1}) as a function of the primary filter, for each $\frac{1}{2}$ mm. of lead.

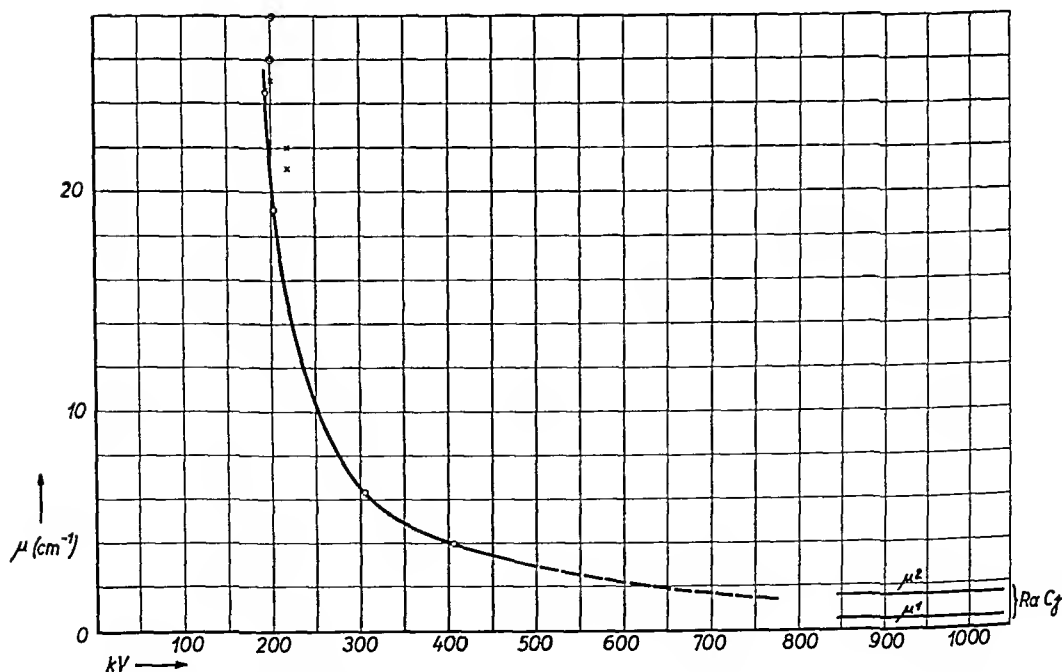


Fig. 11. Coefficient of weakening (cm^{-1}) of lead for various voltages at the tube. \odot Kaye's values; $+$ Berthold's values; \circ authors' values.

of lead, but we also determined the coefficients of weakening and their relationship to the voltage when using 3 mm. of lead at 300 K.V., 7 mm., and 8 mm. of lead at 400 K.V., these relationships being shown by

viously mentioned, and they also have practically the same value between 100 and 200 K.V. but show a definite decrease beyond 200 kilovolts.

In order to determine the thickness of

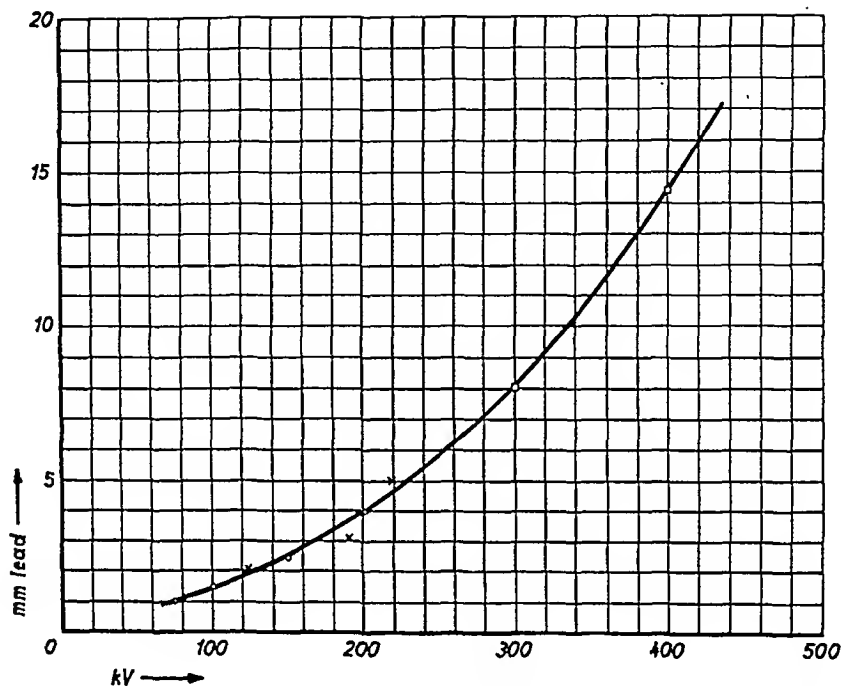


Fig. 12. Protective layer of lead for various voltages at the tube: + German protective standards; O English protective standards; □ lead thickness of a protective value equivalent to 5 mm. at 200 kilovolts.

Figure 11. The value which we obtained at 200 K.V. agrees with that of Glocker and Reuss (3). Also the drop in the curve which was noted by these authors is illustrated very well, as the curve extends toward the harder radiations and it can be seen that the coefficient of weakening at 400 K.V. approximates that which has been determined for the two components of the gamma radiations from radium "C" (4). The absorption curves for lead can also be obtained from the curves which were given in the paper by H. Belmken which was pre-

lead which would be necessary to afford complete protection for these hard roentgen rays we have used as our basis the English standard requirements of 4 mm. of lead for 200 kilovolts. If this value is accepted, by the application of the curve in Figure 9, we find that the ratio for the weakening effect is as 1 to 10,000. If the same weakening effect is desired for 300 or 400 K.V., then a thickness of 8 mm. is required at 300 K.V. and $14\frac{1}{2}$ mm. at 400 kilovolts. The curve in Figure 12 shows these values and that the thickness of lead

which would be required for protection according to German and English requirements falls well within the curve of these figures.

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ATOMS COMBINE IN SUN'S ATMOSPHERE

Not all chemical compounds break up in the intense heat of the sun's atmosphere, Prof. Henry Norris Russell, of Princeton University, recently told the meeting of the National Academy of Sciences.

It was formerly supposed that no chemical molecules could form in the sun. Fourteen different compounds have now been discovered there, six in the photosphere or out-

er layer and eight more above the darker sunspots.

Hydrogen and oxygen occur most frequently in these compounds, hydrogen being the most abundant constituent of star atmospheres. As the behavior of the substances is well known on the earth the extent of their dissociation in the sun and stars can be calculated with some accuracy. The results are in good agreement with observation.—*Science Service*.

THE RELATION OF THE DIAPHRAGM TO GASTRIC PERISTALSIS¹

By MINAS JOANNIDES, M.S., M.D., F.A.C.S., and JOSEPH J. LITSCHGI, M.D.,
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Department of Roentgenology, Grant Hospital, Chicago

IN a previous study² we have noted that the diaphragm has a definite influence on the opening and closing of the cardia. Because of the peculiar sphincter-like structure of the pillars, the diaphragm induces a milking-down contraction which can be felt by inserting a finger into the gastro-esophageal opening through a gastrostomy. By examining the human subject under the fluorescent screen one can detect the terminal point of this milking contraction, manifested by a complete closure of the cardia during inspiratory contraction of the diaphragm. This closure is sufficiently watertight to prevent a barium meal from passing through and thereby causing an accumulation of barium at the cardia, much in the manner of cardiospasm. Coincident with the elevation of the relaxing diaphragm, the pillars also relax, thus allowing the barium meal to pass through the cardia into the stomach. These observations led us to believe that the diaphragm, although primarily a muscle of respiration, exerts a very important influence on the abdominal as well as the thoracic organs.

In the course of our observations on the diaphragm as it affects the cardia, we noticed that the fundus of the stomach ascends and descends along with the diaphragm. It is extraordinary that such a phenomenon should occur in the fundus, especially since we know that there is no definite anatomical attachment between the abdominal surface of the diaphragm and the roof of the fundus.

It is possible that the diaphragm exerts a definite suction on the fundus, so that, as it goes up, it pulls the fundus with it. This phenomenon is noticeable in the upright as well as the recumbent position. The amount of gastric distention or the degree of gastroptosis has little or no bearing on the *ascensus* and *descensus* of the fundus.

Coincident with the changes of the fundus in the vertical plane there are changes occurring in the horizontal plane. As the fundus descends, one notices definite constriction of the upper portion and a dilatation in the lower portion that corresponds with the midgastric portion of the stomach. This is what apparently happens. The portion of the stomach below the level of the incisura angularis is more or less fixed, so that it does not go up and down with the diaphragm, an apparent fixation which causes the stomach to act much like a distended toy balloon. When the upper portion of the balloon is compressed by virtue of its elasticity the balloon expands at its lower portion: the contrary occurs when the upper portion is pulled up. Similarly we have in the stomach a muscular wall capable of distention and contraction. The moving diaphragm exerts upon the fundus a positive pressure of from ten to twenty-five millimeters of mercury. The stomach which is distended with food or fluid is now further influenced by the contracting diaphragm, so that the upper portion of the fundus appears somewhat constricted and the lower part appears dilated. As the diaphragm goes up during expiration it sucks or pulls with it the upper portion of the fundus, which now dilates, while the midgastric area becomes con-

¹Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1-5, 1930.

²M. Joannides: Influence of Diaphragm on Esophagus and on Stomach. Arch. Int. Med., December, 1929, XLIV, 856-861.

stricted much in the manner of the toy balloon. The roof of the fundus and the colon, as well as the abdominal wall, exert also a definite pressure. The action of the colon appears very much like the kneading of dough when it is done with the palm of the hand. After a series of these contractions, small waves begin to appear in the lower portion of the fundus, and one of these initiates a typical peristaltic wave along the greater curvature, beginning at the level of the incisura angularis. When this peristalsis is initiated the wall on the lesser curvature appears to contract, and the antrum now draws into a circular form which is seen to travel towards the pylorus.

In addition to the changes in the form of the stomach we have also certain changes in intragastric tension. From our previous observations we know that the cardia closes with each inspiration so that even milk with barium cannot pass through. At this moment the diaphragm descends and in so doing exerts a definite pressure on the stomach, resulting in an increase of intragastric tension which involves the whole stomach. This tension has a tendency to dilate to a greater or less extent not only the midgastric portion but also the antrum, a phenomenon which is particularly noticeable in the stomach of asthenic subjects. In these individuals there is quite a distinct circular expansion of the antrum and the prepyloric area during each inspiration. It is common knowledge that increased tension in the gastro-intestinal tract will induce peristalsis.

Other factors of great importance are the automatic and rhythmical action of the non-striated muscle of the digestive tract. Alvarez and his co-workers³ have demonstrated that the non-striated muscle of the gastro-intestinal tract is capable of rhythmic contractions under conditions uninfluenced by the nervous mechanism. He has shown that this muscle has a gradient of

rhythmical action and that this gradient has a ratio of eleven contractions for the cardia against two contractions for the pars pylorica. Alvarez has also noticed evidence of high automaticity in the lesser curvature next to the cardia. He says:

We see that local peculiarities in the muscle, with graded differences in rhythmicity, irritability, tone and latent period, probably have most to do with directing the peristaltic wave as it travels over the stomach. As in the heart, so here, the waves probably have their origins in the most highly rhythmic and sensitive area. We may say perhaps that the region on the lesser curvature next to the cardia is the pacemaker for the stomach. It must be remembered, however, that the cavities of the heart and stomach are very different. In one, the impulse travels so rapidly that the organ appears to contract as a unit; in the other, a series of waves travel slowly over the sac, gently kneading its contents.

Alvarez has also shown that there is a difference in the type of contraction of muscle fibers from the fundus and the pars pylorica—contractions of greater amplitude in the pars pylorica than in the fundus. McCrea, McSwiney, Morison, and Stopford⁴ have also noticed in cats, rabbits, and dogs that the waves which began near the cardia, spread downward, producing a constriction ring at the upper end of the pars pylorica, then a bulging of the pyloric portion and finally a concentric contraction ring of that region. This contraction, relaxed as a new wave, arrived at the incisura. These facts demonstrate that a wave initiated in the cardia and fundus is conducted down to the pars pylorica.

It is plausible to assume that the diaphragm is fundamentally a factor in the initiation of these peristaltic waves, since we know that, as it contracts and expands at

³Walter C. Alvarez: *Mechanics of Digestive Tract*. Second edition. P. B. Hoeber, Inc., New York, 1929.

⁴E. D. McCrea, B. A. McSwiney, J. W. Morison, and J. B. Stopford: *Normal Movements of Stomach*. *Quart. Jour. Exper. Physiol.*, 1924, XIV, 379-397.

least twenty times per minute, it also opens and closes the cardiac region, the most sensitive portion of the stomach. Moreover, the pillars exert a milking-down contraction on this region, thus instituting downward impulses in this area. The peripheral portion also, with its *ascensus* and *descensus*, not only changes the intragastric tension but also aids in the contraction and expansion of different parts of the fundus. These contractions and expansions undoubtedly set up action-currents which are carried downward both by the muscle fibers and the nervous mechanism of the stomach.

Some additional data may be of value in this connection. Orndoff⁵ has observed definite differences in the contraction of the diaphragm when the subject is asleep. He says:

In a perfectly natural unmolested sleep, fluorescent screen observations have convinced me that the action of the diaphragm is exceedingly limited and does not consist of the rhythmic excursion noted during other periods while the patient is awake. The change in chest volume, accounting for the same type of respiration, seems to be due entirely or nearly so to the movement of the ribs. On waking up, there is almost always a long inspiration, during which there is noted a full contraction of the diaphragm, with a maximum amount of motion of the subdiaphragmatic viscera, and immediately the usual excursion of the diaphragm is noted with each inspiration.

From this observation we can assume that the diaphragm exerts little or no influence on the stomach during sleep. As soon as the patient awakes and breathes normally the impulses are again sent down to the cardia and the rest of the stomach. Alvarez⁶ has shown that "after a long rest the smooth muscle of the gastro-intestinal tract seems

to get on a hair trigger, so that it will respond powerfully and explosively to a slight stimulus." He states further that this "is the condition of the digestive tract after the night's rest, and it probably has much to do with the fact that most of us have the daily bowel movement in the morning immediately after breakfast." The explanation of this phenomenon is now obvious. The diaphragm, after its nightly rest, is working again, urging the highly sensitive cardia to induce peristalsis. Breakfast is taken and the intragastric tension is increased. The peripheral end of the diaphragm is now ready not only to press the fundus up and down and thus by intermittent changes in the tension to induce peristalsis in the pars pylorica, but it mobilizes its allies, namely, the abdominal wall and the colon, to do their share in kneading the fundus so that peristalsis shall begin.

Just as in the heart where we have many factors influencing the contractility, rhythm, and conductivity of the muscle, likewise here we have several factors which influence the gastric muscle. We must keep in mind also such other factors as psychic shock, hunger, training of the digestive tube, nerve impulses arising in the central and peripheral nervous system, secretory activity, physical changes such as heat and cold applied either externally or internally, hormone activity, and the quantity as well as the quality of the contents in the stomach and intestines. Giving full value to all these factors, yet we must not lose sight of the fundamental mechanism in the muscle itself as influenced by the constantly working diaphragm.

The subjects used for this study were normal adult males and females including hypersthenic, sthenic, and asthenic types. Both the upright and reclining positions were studied. Permanent records of these observations were obtained by means of a seriograph devised to obtain four consecutive films within eight seconds. In our

⁵B. H. Orndoff: Personal communication.

⁶Walter C. Alvarez: *Mechanics of Digestive Tract*, Second edition. P. B. Hoeber, Inc., New York, 1929, p. 23.

stricted much in the manner of the toy balloon. The roof of the fundus and the colon, as well as the abdominal wall, exert also a definite pressure. The action of the colon appears very much like the kneading of dough when it is done with the palm of the hand. After a series of these contractions, small waves begin to appear in the lower portion of the fundus, and one of these initiates a typical peristaltic wave along the greater curvature, beginning at the level of the incisura angularis. When this peristalsis is initiated the wall on the lesser curvature appears to contract, and the antrum now draws into a circular form which is seen to travel towards the pylorus.

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³Walter C. Alvarez: *Mechanics of Digestive Tract*. Second edition. P. B. Hoeber, Inc., New York, 1929.

⁴E. D. McCrea, B. A. McSwiney, J. W. Morison, and J. B. Stopford: *Normal Movements of Stomach*. *Quart. Jour. Exper. Physiol.*, 1924, XIV, 379-397.

TRAUMATIC LUXATION OF THE COCCYX¹

By CARL S. OAKMAN,² A.B., A.M., M.D., MUNCIE, INDIANA

THE patient whose case introduces this paper, a Mr. E. H., white, aged 55, married, a foundry worker, weight 150 pounds, sustained an injury to the coccyx on May 25, 1929. In the course of his duties, he fell from a step-ladder, landing on his buttocks on a wooden box, a corner of which directly struck the coccyx. He experienced immediate pain and was referred to the company physician, who found, the following morning, by rectal examination, an unevenness of the anterior surface of the coccyx, and pain upon pressure, both externally and in the rectum. He diagnosed a dislocation and referred the patient to me for roentgen examination. Lateral projection revealed a forward luxation of the first coccygeal segment, which was displaced a distance almost equal to its own thickness, the rest of the coccyx being symmetrically curved. The outlines of the upper coccygeal and the last sacral element indicated that no bony fusion had existed and the remaining segments showed distinct spacing, as if separated by cartilage. The antero-posterior view gave no hint of the luxation, but showed a vertical line in the first segment that was suspicious of fracture, without displacement. The cornua were not visible; the transverse processes were very rudimentary. Four coccygeal segments were plainly registered, the distal one possibly representing a fusion of two rudimentary elements. The contour of the sacrum and coccyx described a normal curvature, except for the luxated first segment, and there was no lateral deviation.

On May 27 the attending physician reduced the dislocation, by intrarectal digital

pressure, with the patient in a kneeling position. Bowel movements were painful for only a few days, but for three or four weeks the patient complained of an aching sensation. He resumed work in eight weeks.

On October 5 he was referred for another roentgen examination, at which time he said he was free from all pain and ache, except after long automobile rides. Digital examination was painless. The roentgen films showed the same luxation of the first segment, with apparent callus formation anteriorly at the sacrococcygeal junction.

Medical literature shows few and brief allusions to roentgen examination of the coccyx. Careful search failed to reveal any article in roentgenologic journals, and the text-books give little or no information. George and Leonard (1), in their recent volume, illustrate a case of anterior luxation. Jones and Lovett (2) say: "X-ray may or may not be reliable in this region and the antero-posterior view shows only lateral displacement. To obtain satisfactory definition in a side X-ray is, of course, difficult, but often possible with a highly perfected technic." Letters written to 94 roentgenologists brought few helpful replies.

Coccyx (plural *coccyges*) is a word derived from the Greek, meaning a "cuckoo," probably because of a fancied resemblance to a cuckoo's beak. The German equivalent is "Steissbein" and the French is identical with the English. Colloquially, it is called the "tail bone" or "crupper bone." It is a small bone of variable length, forming the caudal extremity of the spine, but destitute of a canal. It comprises four or five segments (rarely three or six), of which the first is the largest and shows some rudiments of the structure of a sacral segment, while the others dwindle into successively smaller

¹Read before the Radiological Society of North America at the Fifteenth Annual Meeting, at Toronto, Dec. 2-6, 1929.

²Dr. Oakman died before proof of this paper could be submitted to him, so that it is unknown what changes he might have made.

observations the subject was made to inspire, hold his breath, and, as soon as the film was exposed, to expel, and again hold his breath. After a few deep breaths the other two exposures of an inspiration with its subsequent expiration were made. The amount of opaque meal given depended on the degree of distention we desired to produce on the stomach.

CONCLUSIONS

This and previous studies of the diaphragm demonstrate that although primarily

a muscle of respiration, it has a definite extra-respiratory function. It induces an opening and closing of the cardia. It produces a milking contraction on the cardia in the region of the stomach that is most automatic and is in the highest degree rhythmic. It compresses and lifts up the fundus and, in so doing, not only changes the form of the stomach but also influences the intragastric tension. One may assume, therefore, that this muscle plays an important rôle in the initiation and maintenance of peristalsis in the stomach.

RARE ELEMENT GIVES NEW KIND OF LIGHT

Rods of quartz heated in the Bunsen burner have been made to send out a new kind of light, the meeting of the National Academy of Sciences has been told.

The quartz, in which a compound of the rare metal neodymium had been dissolved, was prepared by Prof. R. W. Wood, of Johns Hopkins University. When heated, the rods give a light whose rainbow or spec-

trum does not include all the colors but is crossed by dark bands.

A white-hot, incandescent wire, like the wires of tungsten used in the electric lamp, gives white light in which none of the possible colors are missing. The neodymium, however, has the unique property of sending out only special vibrations of its own. Light passed through cold neodymium or other rare earth compounds has these same colors removed from it. No other substance shows this behavior.—*Science Service*.

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of them having been made prior to Roentgen's discovery, and subsequent writers largely ignore its application in lesions of the coccyx. An article by Cyriax (13), in 1922, covers the clinical diagnosis, but does not allude to the X-ray. Several of the roentgenologists with whom the writer has corresponded stressed the point that X-ray examination is unnecessary, because the diagnosis by clinical means is so simple.

Several writers mention that dislocation is commoner in women than in men, because the intersegmental cartilages persist longer and allow displacement instead of fracture, and because many of these displacements occur at parturition: Hirst (18) also attributes man's relative immunity in part to the higher position of the coccyx and the closer approximation of the ischia; he states that during labor there is backward stress on the coccyx, sometimes producing rupture of ligaments, dislocation, or fracture. If displacement occurs, it is posterior, whereas direct external violence produces anterior displacement. Speed (19) says, regarding birth trauma: "Whether there is a true fracture at the sacrococcygeal junction or a stretching of the ligaments which permits the displacement, it is not always possible to decide, even with the help of a roentgenogram." Jolly (20) reported a unique case of escape of the distal segment of the coccyx through the anus ten days after childbirth. Cyriax (13) refers to displacements of the coccyx on the sacrum (*i.e.*, at the sacrococcygeal joint) but has never seen one distal to this point; he says that minor displacements seldom occur after middle life, due to the fact that the sacrococcygeal joint has united, although Piersol (3) states that it is not uncommon for the first segment to remain separate, without fusion to the sacrum or to the second segment.

Outside of birth injury, there is very rarely a posterior luxation of the coccyx. Injuries by direct violence, producing fracture or luxation, practically always show an-

terior displacement. The usual causation is a fall or a kick. Displacement of the coccyx may or may not be accompanied by tilting, or rotation, or both. Cyriax (13) reports cases of luxation due to rheumatic fever, straining at stool, pelvic cellulitis, and sudden effort to prevent falling. He thinks some cases are perhaps due to over-use of the sitting position, by which the coccyx is gradually pushed forward. The chronic sitters were mentioned by Ramsbotham (21) in 1851, who said: "Ankylosis often occurs in women who have been accustomed to sit the principal part of the day, as is the case with milliners."

The symptoms of a recently luxated coccyx are: (1) Pain, aggravated by defecation, sitting, riding, coughing, walking, and coitus, often causing the victims to sit sidewise and to shift position constantly; (2) impairment of bladder function (Speed, 19); (3) constipation, usually due to postponement of stool. Further and diverse symptoms may develop after the lapse of time, which will be discussed under a later heading.

Physical signs of a recent case include: (1) Tenderness on pressure externally or by rectum; (2) ecchymosis or other signs of bruising, though Cotton (22) says that ecchymosis is rare; (3) deformity, which may or may not be visible, and is usually detectable by palpation, either externally or by rectum, or both; (4) mobility of the displaced coccyx.

It may be difficult to differentiate between a fracture of the coccyx and a dislocation. The literature gives scant discussion to this point, and there is reason to believe that errors have been made. The existence of crepitus is by no means universal in fracture cases; probably fracture affects the proximal segment far oftener than it does all the others. An ankylosed coccyx is much more likely to suffer fracture than a jointed one.

If a physician sees a case of injured

and characterless nubbins of bone (vertebrae caudales). Piersol (3) says that data concerning ossification are very unsatisfactory. Each segment has one center, the first may have two; ossification begins in the first piece near birth, and successively later in the others, up to puberty. The first segment presents two cornua, projecting up posteriorly behind the posterior surface of the sacrum; it also presents two rudimentary transverse processes. Both the cornua and the processes are variable, sometimes being well-formed and either rugged or slender, and sometimes being hardly more than tubercles. The first segment is somewhat wedge-shaped, and has greater breadth than length or thickness; it is sometimes asymmetrical. The entire coccyx is usually more rugged in the male than in the female.

The apices of the sacrum and of the first coccygeal element are connected by fibrocartilage, and a few unimportant ligaments. This synchondrosis sometimes shows osseous fusion, and the distal segments also may fuse. Gray (4) says that the last three segments are usually fused with one another, and the last may be bifid; complete ankylosis is likely to result in fracture in the event of trauma. Bony fusion occurs often in the male, and usually at an earlier period.

Variations from the normal curve of the coccyx are common; lateral deviations are very frequent, but apparently never productive of symptoms; exaggerated forward curve is frequent and occasionally impinges on the rectum and produces trouble; the rarer posterior curving may project beneath the skin and induce pressure changes. Absence of the coccyx has been reported (5). One hears occasionally of human beings with a coccyx developed into a true tail, but no authentic report is discoverable in medical literature.

Muscles are attached as follows, according to Buchanan (6): The gluteus maximus

to the back of the upper three segments, close to the lateral border; the sphincter ani externus to the tip; posterior fibers of the levator ani and a portion of the coccygeus to the lateral borders.

The junction of the sacrum and coccyx completes the fifth posterior sacral foramen for transmission of the posterior division of the fifth sacral nerve. No nerves emerge from the coccyx below this. The coccygeal plexus is composed of the fourth and fifth sacral nerves (except the visceral branch of the fourth anterior sacral), the coccygeus (anterior and posterior branches), and probably the inferior hemorrhoidal branch of the internal pubic. On the anterior aspect of the coccyx are two ganglia (Luschka's gland), belonging to the pelvic sympathetic system. These ganglia are united to each other by a small filament and are connected by other filaments to the last sacral ganglion of the chain forming the pelvic sympathetic (Hamant and Pigache, 7). Jointly these nerves supply sensation to the integument over the coccyx, around the anus, and the intervening area, and innervate the levator ani, sphincter ani, and coccygeus muscles.

The subject of dislocation of the coccyx has had much discussion in the past. Stimson (8) says that descriptions given by earlier writers were questioned in the early part of the twentieth century, and quotes Boyer as maintaining that the lesion never occurred; the matter was somewhat connected with coccygodynia, as cause and effect, but the actual occurrence of dislocation was well enough attested by several reports, mentioned by Stimson (Malgaigne, Roeser (9), Bonnafont (10), Mouret, 11), and also reports by Skene (12), Cyriax (13), Jones (14), Gehrung (15), Drueck (16), Petit (17), and Hirst (18). Undoubtedly some of the cases reported as dislocation were really displacements due to fracture, and the converse may be true. Practically none of the reports include roentgen evidence, many

and irritation of sensory nerves through disturbance of the coccygeal ganglion. Hirst (18) remarks that after injury the lesion has a poor chance to heal, because of stress in all the usual activities of life, especially defecation, sitting, and rising.

The case report at the beginning of the present article shows so well the value of precise knowledge, as furnished by roentgen examination, that it needs no argument to urge the more widespread use of this method. Clearly, the lateral view is required, and with modern refinements of technic it ought to be possible to obtain such views in all cases of suspected injury. It is true that the interpreter must guard against being deceived by the anatomical variations, but I have seen in the literature no mention of variation that simulates true luxation. The recorded variations include lateral deviations and increased angulation, either forward or backward. In antero-posterior projections centering over the pelvis, such as are taken for any bony pathology in this area, or for the lower part of the urinary tract, there is always an image of the coccyx. The variations in contour, length, number of segments, ossification, and deviation from the midline have been noted by every one, but it is well known that luxation practically never occurs laterally, so that error in that respect can hardly occur. A series of lateral projections on healthy subjects was recently made by the writer, and there was found to be great divergence in the degree of curvature, but nothing resembling a dislocation. These anomalous curvatures show an intact sacrococcygeal joint, and intact intersegmental joints, whereas a luxation will show an abrupt irregularity at some one of these joints in the lateral view. In films loaned by Dr. H. B. Podlasky the antero-posterior view showed an over-lapping of the first and second coccygeal segments that seemed quite positive evidence of dislocation. No lateral view was taken. It seems probable that dislocation may occur oftenest at the sacro-

coccygeal joint, but no reliable data are available, because the exact point of dislocation is rarely mentioned in reports, or, if it is, the opinion is based on physical examination, and X-ray evidence is never quoted. Those injuries which, upon roentgen examination, show abrupt and pronounced angulation, sometimes as much as 90 degrees, but little or no slippage at the joint, are very puzzling, because some normal coccyges show similar angulation. Therefore it becomes difficult to say in any given case of injury whether the angulation is pathologic or not. It is well known that coccygodynia sometimes occurs without detectable signs of displacement, due to conditions such as arthritis, periostitis, necrosis, etc., and such conditions may affect a coccyx that is naturally angulated, especially after trauma. Dervieux and B  lot (41), in 1926, reporting a case of coccygeal injury, say that the roentgen reading of these cases must be guarded; but if lateral roentgen examination should be made routinely, and the data accumulated, it would undoubtedly result in a greater power of discrimination.

These cases of injury sometimes have an important bearing in industrial work, attention being called to this point in 1910 by Courtois-Suffit and Bourgeois (42). The value of roentgen evidence in compensation disputes or damage procedures is well known. Dr. Podlasky's case (*cit. supra*) was one of industrial accident and it led to a long period of suffering and finally to surgical resection.

In making film records of the coccyx, the presence of a distended bladder or of gas in the rectum usually impairs the detail of the antero-posterior view. Kaisin (43), however, recommended the injection of air into the rectum. The best films are usually obtained with the Potter-Bucky diaphragm, using a restricting cone, a fine focus tube, careful immobilization, especially for the lateral, and the maximum practical distance. In the resulting image by the antero-poste-

coccyx long after the accident, diagnosis may not be so easy, and he is apt to fall back on the convenient term "coccygodynia." This is the word that has been in turn respected and later condemned. In 1859 Sir J. Y. Simpson (23) published his article, describing the cases of persistent pain in the coccyx, and dignified the condition as a separate entity under the term "Coccygodynia," a word which "caught on" and had long years of popular use. His description has hardly been improved upon, since he had a good understanding of the various kinds of pathology that may underlie it. He discovered early reports of coccygeal injury, including those by Smetius, sixteenth century, and Van Meeren and Gahrlep in the seventeenth. Simpson did tenotomy for relief of his first cases, but later did resection. However, the credit for the first resection must be given to Nott (24), of New Orleans, whose report appeared in 1844, describing a case of "neuralgia" from caries. Prior to this, in 1841, Blundell (25) had suggested the operation. Simpson inspired Scanzoni (26) to devote twelve pages to the subject in his text-book, published in 1861, and laid the foundation for what amounted almost to a fad for coccygectomy. However, the pendulum swung after a few decades, when it was found that this procedure was not uniformly successful, and we find Beach (27), in 1899, saying that resection in chronic cases of pain is "an operation notably unsuccessful." In Cotton's work (22), 1924 edition, appears the statement: "Most of the cases, even when there is a history of some injury, are essentially localized symptoms of a psychosis, 'hysteric,' as we name these localized psychoses. In such cases operation will not help the patient and will only discredit the operator." Meanwhile, it has been shown by various writers—C. Beck and V. S. Cabot (28), Gant (29), Hirst (18), Werner (30), Smith (31), Tillaux (32), Whitead (33), Blount (34), Boland (35), Tédénat and Simesaël (36),

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In 1914 Yeomans (38) reported a new method of treatment by injections of alcohol at the site of pain. An article had appeared on the same subject by de Vézian in 1907 (39). The successful use of the faradic current by Seeligmuller and Grafe was mentioned in the 1904 edition of von Bergmann's "Surgery."

Some of the gynecologists in the past have been inclined to ascribe coccygodynia in certain cases to metritis, salpingitis, prolapsus uteri, prostatic disease, hemorrhoids, fissure, rectal tumor, etc. Hamant and Pigache (7), 1914, in a critical study, deplored this inclination. Yeomans (40), 1919, classified some cases as "symptomatic," or referred pain, due to disease of the central nervous system, such as hysteria, neurasthenia, irritable spine, traumatic neuroses, tabes, toxemia, and "habit pain."

In passing, it should be mentioned that the original term "coccygodynia" gave way to "coccygodynia," which was substituted because it is etymologically more precise. Colloquially it is variously known as "neuralgia of the rectum," "rheumatism of the rectum," "elongated spinal column" (Drueck) (16).

It seems to be fairly well agreed that the most common cause of coccygodynia is injury, either recent or remote, severe or mild, single or repeated. Stimson (8) thinks that dislocation and fracture are commoner than the reports indicate. Cyriax (13) stresses minor displacements and the subsequent occurrence (in either major or minor degree) of synovitis in the sacrococcygeal joint, adhesions, periostitis, periarticular thickening,

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rior view, it is usually possible to note the number of coccygeal segments, though the lateral view may sometimes be necessary for a correct count. The antero-posterior view also shows the characteristic shape of the first segment, its transverse processes, and occasionally its cornua, and it registers all lateral deviations. If the curvature is excessive, the coccyx will appear foreshortened, the segments seeming to overlies each other, and only a lateral film will reveal them and their interspaces separately. The lateral view will sometimes register the coccygeal and sacral cornua. Fractures are most likely to occur in the first segment, and be visible in the antero-posterior view, because the line of fracture is most often vertical. In Butler's (44) case the fracture is visible in both views, but the displacement is visible only in the lateral. Luxation may readily escape detection in the frontal projection. In the writer's case it is probable that the coccygeal cornua were broken off, allowing the forward slipping of the first segment.

In the course of correspondence with nearly a hundred roentgenologists on the subject of this article, replies were received from fifty-nine, and films or prints were loaned by eight. Fifteen others stated that they had seen cases, but for various reasons the film record was not available. Four mentioned that roentgen examination is unnecessary because the diagnosis is so easy by physical examination. I wish to take this opportunity of thanking all my colleagues who have answered my appeal, and especially those who sent roentgen records, including Dr. H. B. Podlasky, Dr. G. W. Grier, Dr. P. F. Butler, Dr. W. E. Chamberlain, Dr. P. M. Hickey, Dr. W. A. Evans, Dr. Lawrence Reynolds, Dr. H. A. Spilman, Dr. Samuel Brown, and Dr. T. A. Groover.

CONCLUSIONS

Little attention has been paid in the past to the roentgen examination of the coccyx.

Lateral views are almost necessary in a film study of this area.

The normal coccyx has many variations of length, curvature, fusion, and bony markings, which may cause confusion in interpretation.

Complete and true dislocations, either of one segment or of the entire coccyx, can probably be easily detected on the films. Minor displacements may create doubt.

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tained. I do not think these studies should ordinarily be made on a 14 by 17 film, a size which would include the entire lumbar column. It is our practice to make them on a 10 by 12, to cover the painful area, and I think the information we obtain is apt to be more definite. This, of course, predicates co-operation on the part of the surgeon, the attending physician, and the receiving ward.

DR OAKMAN (closing): Dr. Doub, in his discussion, referred to certain indications which are associated with coccygeal pain. It is quite true that the profession at one time, and in particular the gynecologist, was very apt to attribute coccygeal pain to pelvic con-

ditions. I think that a more common-sense view is now prevalent, which attributes almost all cases of coccygeal pain to coccygeal pathology.

The subject of coccygeal pain is of occasional importance in industrial work. This was brought out some seventeen years ago by a French writer, and numerous cases are recorded in the literature, cases wherein injuries to the coccyx have proved to be compensation cases.

One or two writers have insisted that dislocations have never occurred except at the sacro-coccygeal junction. Some of the slides which I have shown indicate that a dislocation may occur at other points.

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DISCUSSION

DR. H. P. DOUB (Detroit): I believe that Dr. Oakman is to be congratulated for bringing this subject before us, for discussing the literature so thoroughly, and for presenting the collective opinion of the roentgenologists of the country concerning this condition. It is one which is rather infrequently met with, but, nevertheless, is very important because of the many cases referred to us for evidence of possible injury, indicated by pain in this area.

The principal point in this whole discussion is to be able to distinguish between traumatic luxation, fracture, and the anatomical variations which are very common in this bone. This is especially important because these patients who come for examination often have severe symptoms, so that one must make a definite roentgenological diagnosis.

In the study of these cases one finds many variations from the generally accepted normal, but most of them will be found to be due to anatomical variations. In our hospital series a number of cases were operated upon, but, unfortunately, only one of these cases had had X-ray examination previously and the roentgenograms were negative for fracture or dislocation.

From the patient's standpoint, coccygodynia is a very important condition because of the severe pain of which complaint is made. In these cases, however, several conditions should be considered. First, we believe that many of these cases are associated with hysteria and psychosis of some type. In the second place, some of these patients are found to have disease in the sacro-iliac articulation or lumbar spine, with referred pain to the coccyx.

I wish again to congratulate Dr. Oakman upon his presentation of this subject.

DR. JOHN T. FARRELL, JR. (Philadelphia): Dr. Doub has congratulated Dr. Oakman upon his presentation of this subject, but I think the Society is to be congratulated upon receiving such a scholarly discussion of such an important subject.

Pain in the back is very important to the patient, and it is also important to the doctor. This is particularly true in the case of industrial accidents.

We have all known that variations exist in the coccyx, and I think that Dr. Oakman has well pointed out the importance of fundamental anatomical knowledge. It seems to me that the diagnosis of fracture of the coccyx is rarely going to be made without clinical assistance and digital examination.

There is one point which occurs to me, though it seems almost too obvious to mention, and that is the matter of technic. So many of us in dealing with conditions of the spine in clinics are confronted by men who refer patients for just general spinal examination. It is true that it is often impossible to localize the lesion, but in general I think we may say that the smaller the film in relation to the area of suspected involvement, so much more exact will be the information that is ob-

tained. I do not think these studies should ordinarily be made on a 14 by 17 film, a size which would include the entire lumbar column. It is our practice to make them on a 10 by 12, to cover the painful area, and I think the information we obtain is apt to be more definite. This, of course, predicates co-operation on the part of the surgeon, the attending physician, and the receiving ward.

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MEASUREMENT OF LENARD RAYS

By LAURISTON S. TAYLOR, WASHINGTON, D. C.

Abstract.—An investigation is described in which the correct measurement of the electron output—Lenard current—from high voltage cathode-ray or Lenard-ray tubes is attempted.

The evidence presented shows that a Faraday chamber of proper dimensions may be used to measure the Lenard-ray current which at any point is shown to be a linear function of the total tube current. The open-plate method of measuring Lenard currents yields results which are consistently too low, although under the conditions here used they bear a constant relationship to the Faraday chamber measurements. The open-plate measurements are, therefore, also a linear function of the total tube current. The condenser

method of measurement (Thaller) yields measurements above or below those of the Faraday chamber, depending upon the relationship of the atomic numbers of the two plates. Moreover, the current measured by this method is not a linear function of the total tube current and hence does not bear a constant relationship to the Faraday chamber measurements under the conditions used. Measurements of the range of scattered electrons from Lenard tubes operating at about 160 K.V. peak, indicate a maximum of about 15 mm. in air, which is equivalent to an energy of about 60 electron kilovolts. By means of a variable Faraday chamber described, it is possible to obtain a measure of the velocity distribution of the scattered electrons.

I. INTRODUCTION

(1) *Early Use of Lenard Tubes*

IN 1925 Coolidge described a high voltage hot cathode tube of the Lenard type by means of which high speed electrons passed through a thin (.0015 in.) metal window from the tube into the open air.¹ His principal improvement over the original Lenard tube lay in the very large increase in the number and speed of the electrons transmitted through the foil window. He has constructed a cascade tube operating at 900 K.V. and 2 ma. on an induction coil. More recently Slack² has developed a similar tube having a very thin (1 micron) concave glass window and operating up to at least 350 K.V. in a single stage.

Since the introduction of the Coolidge tube, a wide variety of investigations have been undertaken having in view its applications in the fields of physical, chemical, and

biological research. Coolidge and Moore³ made the first qualitative studies of various effects of the electrons upon substances in air as well as the effects upon animal tissue and bacteria. McLennan⁴ and his co-workers have since carried out very extensive studies of their effect upon chemical reactions. In the biological field, the most comprehensive studies have been carried out by Schaeffer and Witte,⁵ and Baensch and Finsterbusch,⁶ of whom the former made the first attempt to apply physical measurements of Lenard-ray currents to biological reaction.

The greater part, however, of all this work has been done with very little accurate knowledge of the magnitude of Lenard-ray quantities involved. The object of the present communication is to describe a study

¹W. D. Coolidge and C. N. Moore, Jour. Frank. Inst., 1926, CCII, 722.

²J. C. McLennan, Perrin, and Ireton, Proc. Roy. Soc., 1929, CXXXV, 246.

³W. Schaeffer and E. Witte, Strahlentherapie, 1929, XXXI, 415.

⁴W. Baensch and R. Finsterbusch, Strahlentherapie, 1929, XXXIII, 399.

¹W. D. Coolidge, Jour. Frank. Inst., 1926, CCII, 693.

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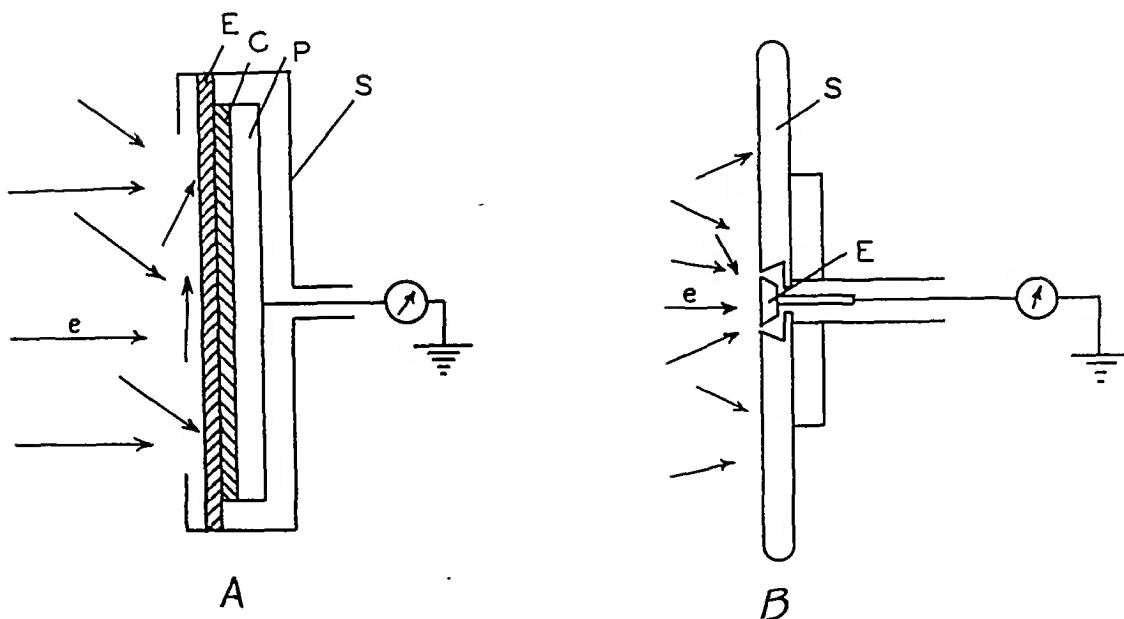


Fig. 1. Lenard-ray collectors: (a) Schematic diagram of Lenard-Thaller condenser collector for measuring Lenard rays; (b) Cross-section of Taylor open plate collector.

of several methods for measuring the current of the high speed electrons in air under conditions suitable for general experimental application.

To avoid possible confusion in speaking of the various currents it is well to differentiate between them. By the *total current* is meant the electron stream leaving the filament, irrespective of its ultimate destination. There is also a current composed of high speed electrons in air, called the *Lenard current*. Its current density—which is directly proportional to the number density and velocity of the electrons—varies with distance and direction from the window. Most of the measurements described below are in terms of current density.

Experiment shows that it is insufficient and often misleading to measure the electron current at some point outside the tube in terms of the current through the tube and the voltage applied to the tube. While this may be satisfactory for reproducing conditions with a given set-up, many complicating factors render it useless from the view-

point of reproduction under other slightly different conditions.⁷

(2) Methods of Measuring Lenard-ray Currents

Three methods of measuring Lenard-ray currents were announced almost simultaneously. Thaller⁸ used a modification of a method described by Lenard⁹ and shown diagrammatically in Figure 1-A. The high speed electrons, *e*, pass through a layer of noble metal, *E*, about 0.001 mm. thick, deposited on a somewhat thicker layer of copper oxide, *C*, or other insulating material, to the backing plate, *P*, and thence through a galvanometer to ground. The current through the galvanometer is then taken as the Lenard current.

The writer¹⁰ has described some prelimi-

⁷It might be mentioned that, at the outset of this work, a number of erroneous results were obtained due to what later proved to be the improper measurement of the tube current alone.

⁸R. Thaller, *Strahlentherapie*, 1929, XXXIII, 263.

⁹P. Lenard, *Ann. Phys. u. Chem.*, 1898, LXIV, 288.

¹⁰L. S. Taylor, *RADIOLOGY*, April, 1929, XII, 294-296.

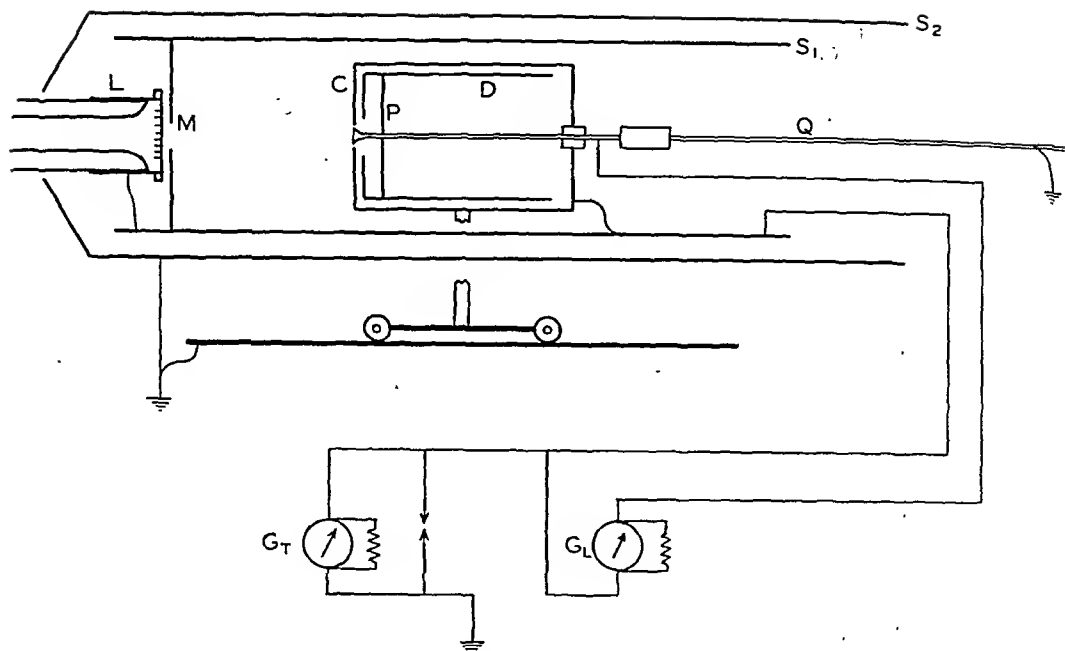


Fig. 2. Diagram of experimental set-up for comparing the condenser, open plate, and Faraday chamber methods of Lenard-ray measurement.

nary measurements made by the apparatus shown in Figure 1-B wherein the electrons were allowed to impinge upon a small aluminum plate, *E*, surrounded by an earthed guard plate, *S*, so designed as to avoid error due to electrons entering the space between *E* and *S*. The current from plate to ground as measured by the galvanometer was taken as the Lenard current.

Schaeffer and Witte¹¹ expressed their intensities in terms of the air ionization produced, having made the necessary corrections for the additional ionization produced by the associated X-rays. This method aims to obtain a measure of the energy, whereas the preceding method deals only with the current; therefore, the measurements cannot be directly compared.

The ionization currents produced by Lenard beams are relatively large. For example, consider an electron beam having a current density of only 8×10^{-8} amp./cm.² (as in some of the work described below)

and assume complete loss of velocity of all the electrons—which have an average speed of 125 electron kilovolts. Using Eisl's¹² value of 32.2 volts loss of velocity to yield one pair of ions, it is found that 1.9×10^{15} ion pairs are formed per second by this stream, which should give a saturation current of 3×10^{-4} amperes per square centimeter—4,000 times the initial electron current.

In spite of the advantage of yielding conveniently large currents, other experimental difficulties, discussed below, render the ionization method of Lenard-ray measurement less satisfactory, however, than the electron current method. In this study we have used a Faraday chamber method as a basis of comparing the first two methods above.

The Lenard current is measured in terms of the unit previously proposed by the author,¹³ as that beam having an *electron current density* of one E.S.U. per square centimeter normal to the direction of the

¹¹W. Schaeffer and E. Witte, *Strahlentherapie*, 1929, XXXI, 415.

¹²A. Eisl, *Ann. der Physik*, 1929, III, 277.

¹³See Footnote 10.

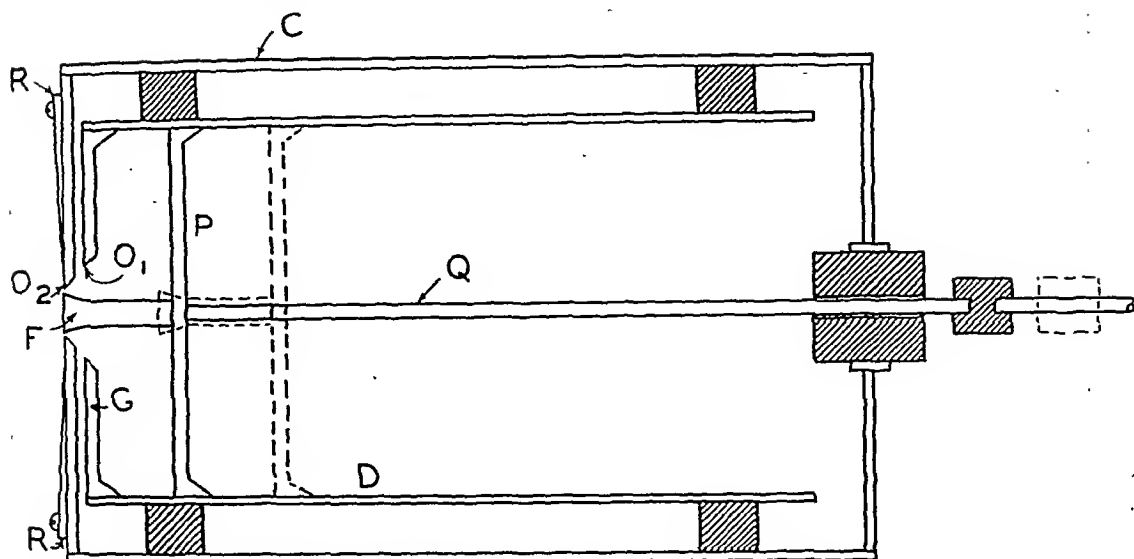


Fig. 3. Cross-section of adjustable Faraday chamber. Broken lines indicate position of plunger when drawn back. Cross-hatched section indicates hard rubber.

beam. This was called the "lenard" and was designated by the letter L. It is obvious that, due to scattering of the electrons in air, the current density will be essentially uniform over only a very small area. Hence it was thought desirable to restrict the measurements to the current over an area only 1 cm. in diameter rather than some 10 cm., as in Thaller's system. The intensity of the beam striking the center of such a large collector as Thaller's will be very different from that striking the edges, so that in effect he measures an average intensity. As mentioned, this type of measurement is not directly comparable with Schaeffer and Witte's.

II. EXPERIMENTAL INVESTIGATION

(1) Tubes and Generating Equipment

Two types of hot cathode Lenard tubes were used in this investigation. The first was the Coolidge type, having a large flat metal foil window supported on a honeycomb grid. The foil was of nickel about 0.03 mm. thick. The tube operated continuously on a metal four-stage mercury diffusion pump. The second tube was of the

Slack type, having a drawn-in glass window about 0.002 mm. thick, with an effective opening of about 3 cm. diameter. This tube was sealed off the pumps.

Both tubes were designed to operate at about 350 K.V. peak and were tested by us up to 325 K.V. (the limit of our system). The window of each was cooled by radiation and conduction alone; and, to permit steady continuous operation over periods of several hours, comparatively low tube currents were used—of the order of 20 micro-amperes for the Slack tube and 100 micro-amperes for the Coolidge tube. When comparing the observations made with small currents against those made using larger currents of shorter duration, no essential differences were observed except in the magnitude of the Lenard currents measured.

Since the range of the electrons in the thin windows varies as the square of their voltage, according to the Thomson-Whiddington-Bohr law, it is obvious that for a given tube current the minimum heating of the window would occur when applying strictly constant voltage to the tube. It has been observed that, for such tubes as here used, most electrons having a velocity under

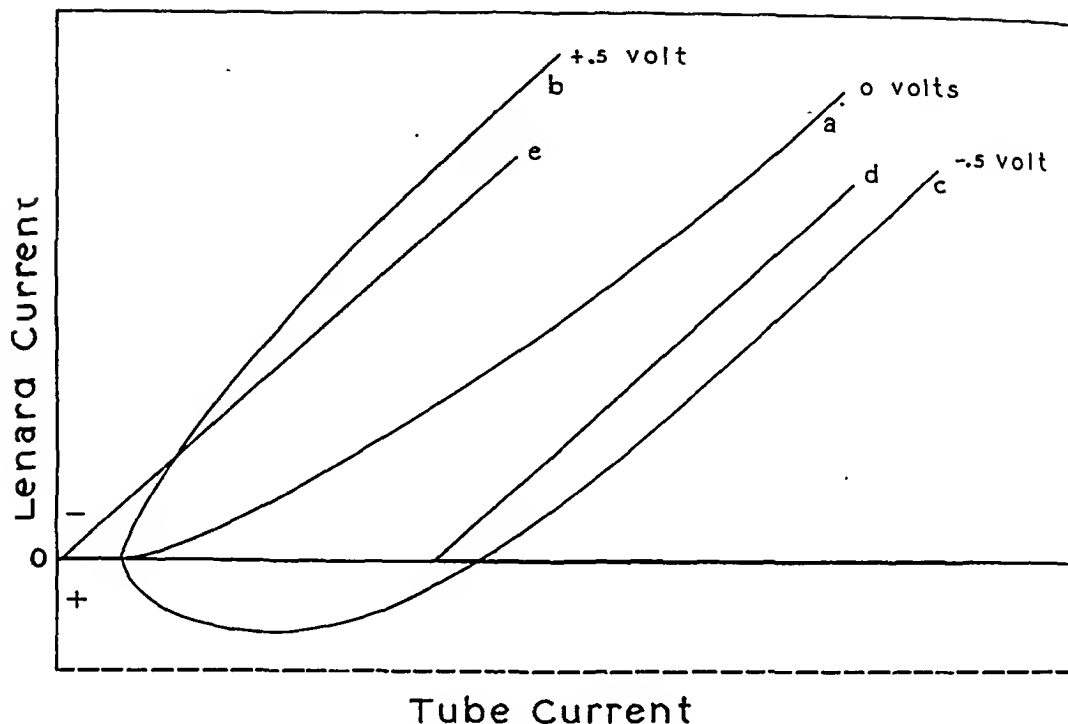


Fig. 4. Curves showing effect on Lenard current readings caused by poor electrostatic shielding and by potential differences between collector and guard ring. Scales of same order as in later figures.

75 electron kilovolts are completely absorbed in the window, and hence are effective only in producing heat and a few X-rays. Thus when applying other than constant voltage to the tube only that portion of the wave above 75 K.V. is effective in producing the results sought.

Not having available a suitable constant voltage source for this work, a disc mechanical rectifier was used in which rectification occurred over approximately 15–20 degrees. For convenience of measurement, the anode and window of the tube were at ground potential and a maximum of about 160 kilovolts was applied to the cathode.

Tubes, generating equipment, and measuring apparatus were placed for safety in a large room lined with $\frac{1}{4}$ -inch lead, and all controls and indicating instruments were brought outside and so arranged as to permit the variation and measurement of all quantities without the necessity for entering the room. This had the one undesirable

feature of requiring very careful electrostatic shielding of all parts of the apparatus to prevent the sensitive galvanometers from picking up electrical disturbances from the mechanical rectifier and high tension leads.

(2) Apparatus Used for Comparing Lenard-ray Measurements

In order to facilitate the comparison between the three systems outlined above, namely, Thaller's condenser system, Taylor's open plate system, and the Faraday chamber, a single Lenard-ray collector was designed in such a manner as to readily measure the electrons according to any one of the methods.

The collector, C, in Figure 2, was mounted on a grounded track so as to be movable through a distance of about 25 cm. from the tube window, L, in any direction from zero to an angle of 150° with the axis of the tube. The outer case of the collector.

the copper gauze shield, S_1 , and the tube anode were connected together through a galvanometer, G_T , to ground. This system was surrounded by a second copper gauze shield, S_2 , which was grounded. Both S_1

large adjustable Faraday chamber. The plunger, P , supports a collector, F , of which the outer end, having a diameter of 9.8 mm., passes through the opening, O_2 , in the outer case, C , with a clearance of 0.1 millimeter.

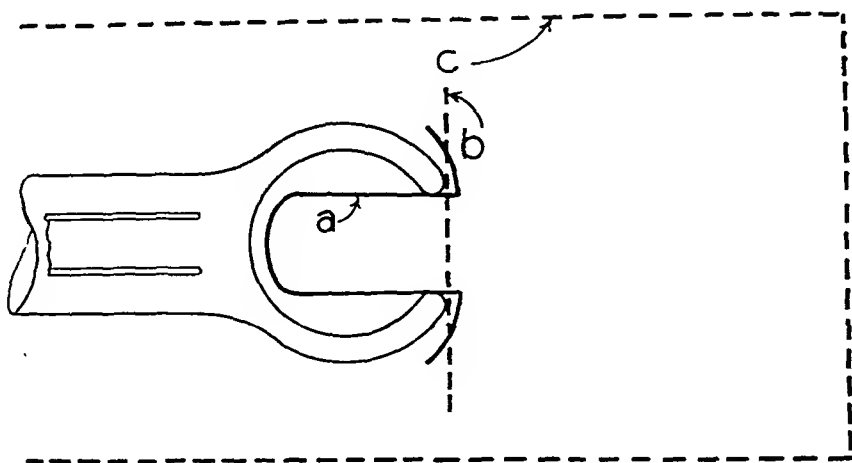


Fig. 5. Arrangement of collectors a , b , c , for measuring total Lenard current when the air volume in front of Slack tube is varied.

and S_2 were so slotted as to permit the ready movement of the collector along the track.

Figure 3 shows a detailed diagram of the collector used as a basis of comparison. The inner cylinder, D , carefully insulated from the case, C , contained a plunger, P , which could be moved by means of the rod, Q , from outside the lead room. Both inner cylinder and plunger were connected through the galvanometer, G_L , to the galvanometer circuit, G_T , as indicated. Galvanometers, all lead wires, shunts, etc., were completely surrounded by earthed shielding. Thus the galvanometer, G_T , indicates the total electron current of the tube, made up in part of the small electron current to the Faraday chamber as measured by G_L . A current measuring system placed thus in the grounded circuit is preferable when dealing with currents as small as those involved, since it does not measure any of the corona losses in the high tension circuit.

The complete collector is essentially a

The Faraday cylinder, D , has its front end, C , adjustable in position along the axis so as to vary the spacing between C and G . The opening, O_1 , in the Faraday chamber, and O_2 in the case are tapered in such a manner that all the electrons (except those at a glancing angle) incident on the plane of O_2 will pass into the chamber when the plunger is drawn back. On the front of the outer case is a thin tapered ring by means of which thin metal covers may be securely clamped over the opening, O_2 .

This system may be used for any of the three methods described above. By placing the collector, F , flush with the outer face of the case we have the open plate system. By moving the plunger back into the cylinder, D , a Faraday chamber is obtained. To obtain Thaller's condenser system, a thin metal foil and insulator may be clamped under the ring, R , and then F moved up to just bear on the insulator under the foil. Moreover, by moving the piston back while the opening,

O_2 , is covered, we can effectively measure the transmission of the foil and insulator by the Faraday chamber method.

Care must be taken to properly identify any currents measured, since the total tube

of M striking the outer conducting wall of the tube; (4) the electrons striking the shield, S_1 , and the Faraday case front, C ; (5) the electrons entering the Faraday cylinder, D . If the shields, S_1 and S_2 , are re-

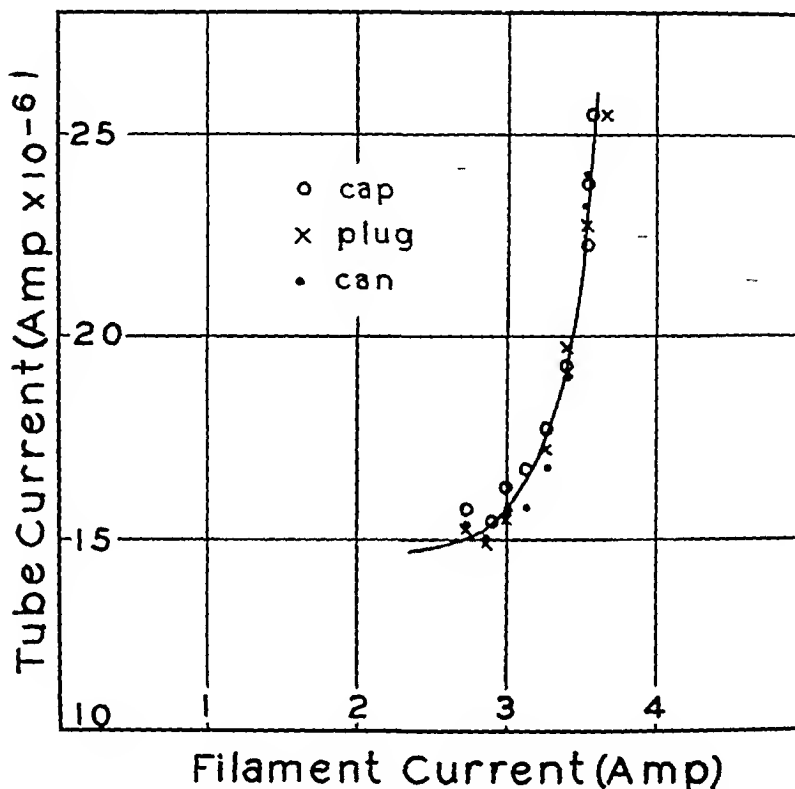


Fig 6 Total Lenard current as a function of filament current.

output may be considered as made up of a number of separate parts. A correct measure of the tube current is not obtained by measuring simply the current between anode and ground, since this does not measure the electrons that pass through the window. The total tube current consists of the following parts: (1) the current to the anode (including the window), of which a large part is due to electrons scattered from the primary cathode beam within the focusing tube; (2) the current to the diaphragm, M (Fig. 2); (3) the electrons scattered back

moved, the Part 4 will be reduced while the Part 3 will be increased. Moreover, the amount of these changes will depend to a considerable extent upon the relative positions of the diaphragm, M , and the Faraday case, C .

Figure 4 shows a series of curves of the Lenard current, measured with the open plate collector, as it varies with total tube current for a fixed voltage on the tube. These are given to indicate, without going into detail, the necessity for careful shielding and the elimination of stray potentials

in the system. Curves *a*, *b*, and *c* were taken with both shields, S_1 and S_2 (Fig. 2), removed; *a* with the center electrode at exactly the same potential as the case; *b* and *c* with the center electrode maintained at

chamber. Since the entire space (outside and inside the chamber) is highly ionized, it must be assured that the net flow of current to the collector is simply the primary electron current—that other positive and nega-

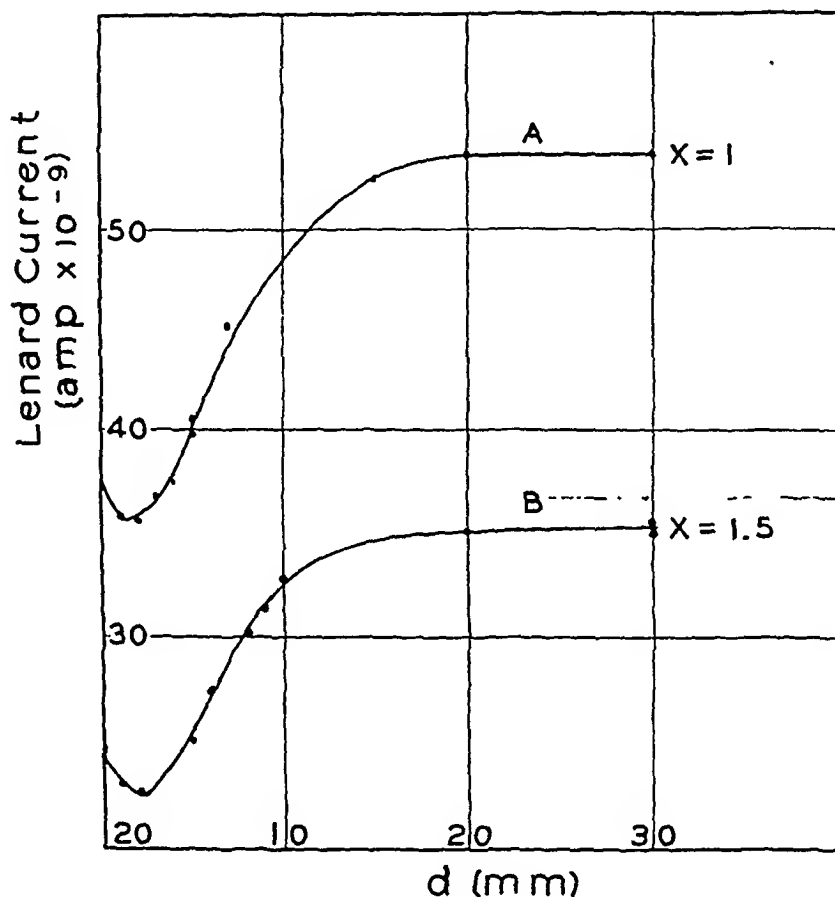


Fig. 7. Lenard current as a function of the distance d which the plunger is withdrawn, for two distances x between collector face and tube window.

about 0.5 volt above and below the case potential, respectively. The slight displacement from the origin was due to stray field disturbance. Curve *d*, taken with only S_2 removed, is linear but passes far from the origin due to an excessively large field disturbance picked up by S_1 . Curve *c* for a completely shielded system is linear and passes through the origin.

(3) Measurement of Total Electron Current

The first point investigated was the correctness of the indications of the Faraday

tive ions either recombine or reach the collector in equal numbers.

One way of testing this is by measuring the apparent total tube output current, say, as a function of the filament current, while varying over wide limits the air volume in front of the tube. This was accomplished in the case of the Slack tube by inserting first a closed lead cylinder, *a* (Fig. 5), into the window, so that there was practically no volume of air to be ionized; second, covering the opening with a flat plate, *b*, so that only the space inside the mouth of the win-

dow was ionized, and third, enclosing a large volume of air in front of the tube with a can, *c*. With the Coolidge tube a can only was used. A plot of the total tube current

the total Lenard current. That the current, measured by the Faraday chamber, is a definite fraction of the total is supported by mutually consistent results discussed below

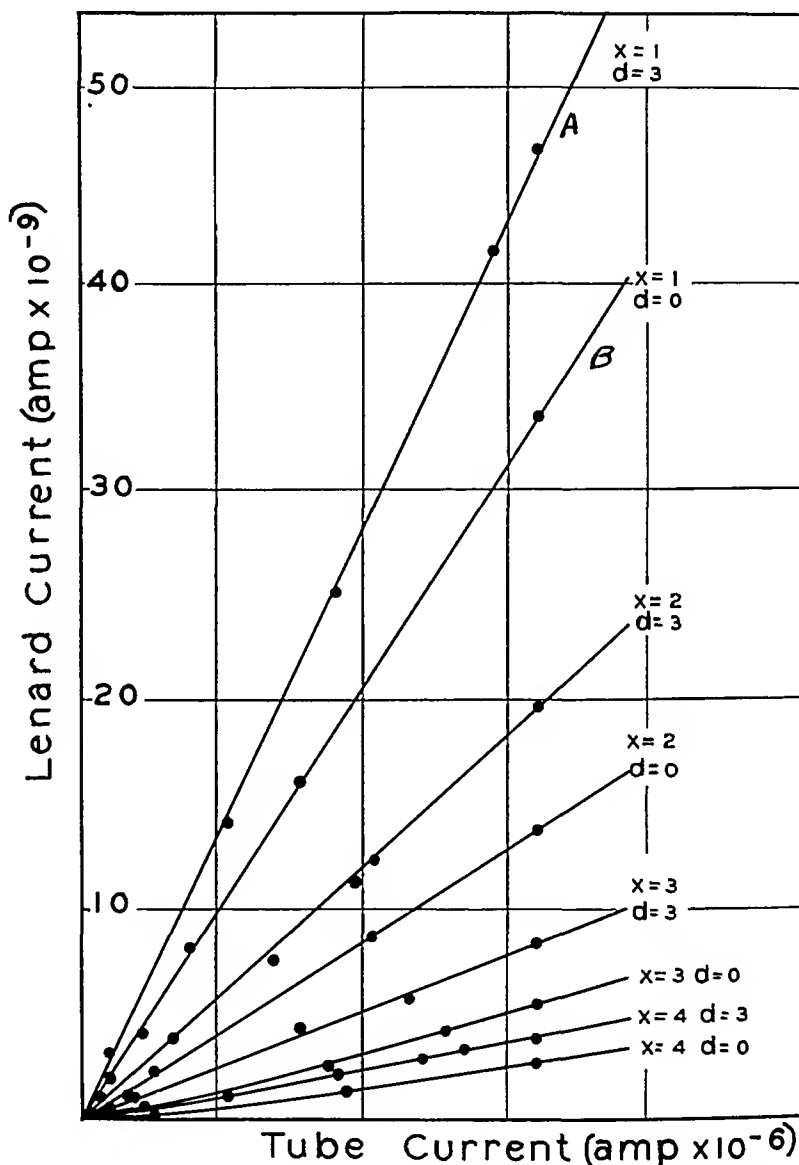


Fig. 8. Lenard current as a function of tube current for different values of x and d . The ratio of the *A* curves to the corresponding *B* curves is the same for all values of x . Values of x and d are indicated in centimeters

as a function of the filament current for these three sets of conditions (Fig. 6)—giving the same results for all three cases—proves that the current measured by G_T was

(4) Comparison of Open Plate and Faraday Chamber Methods

The next point investigated was the effect

of moving the collector, F , back from the position where it was flush with the outer case. Two curves, A and B (Fig. 7), show the change in current to the Faraday cham-

identified as follows: (a) when the collector is flush with the outer case, as the *plate* or *collector plate current*; (b) when the current no longer changes with d , as the

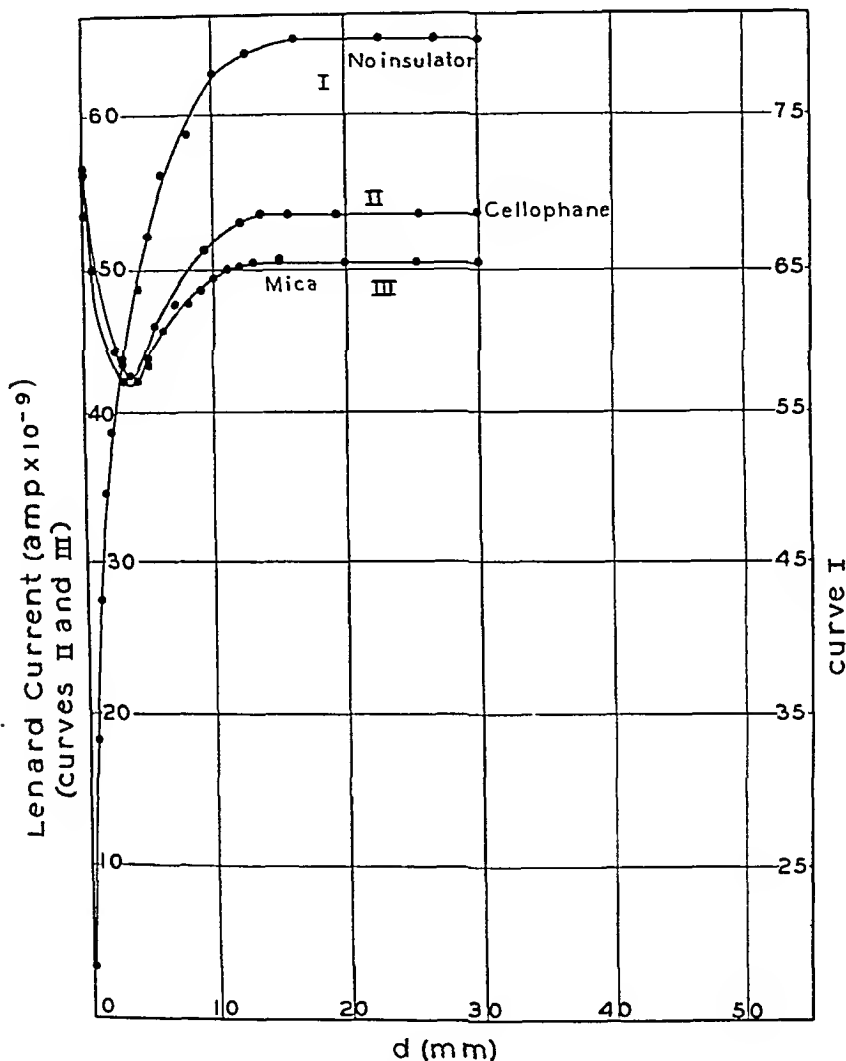


Fig. 9. Lenard current as a function of the distance d for different dielectrics between the aluminum collector window and plunger.

ber as a function of the distance d between F and the front face of the outer case, C (Fig. 3). It will be noticed that the current for values of d greater than about 1.5 cm. is about 33 per cent greater than for conditions where F and C are flush.

To avoid confusion in speaking of the currents measured by G_L for different positions of the collector, F , the currents will be

complete or *complete Faraday current*; (c) when the current is intermediate between the two cases above, as the *intermediate current*. Two cases where the distance, x , between C and the Lenard tube window is 1.0 and 1.5 cm., are shown by Curves A and B , respectively. Other conditions remaining the same, the ratio between the plate and complete currents was approximately the

same for all values of x and all tube potentials used. Since the velocity distribution of the electrons in the beam subtended by the opening, O_2 , will vary with both tube potential and the distance, x , hence, the ion-

reached when d reaches 20 mm., for the particular arrangement of the inner cylinder. Both of these points may be shifted slightly by changing the size of O_1 or the distance between O_1 and O_2 . The minimum

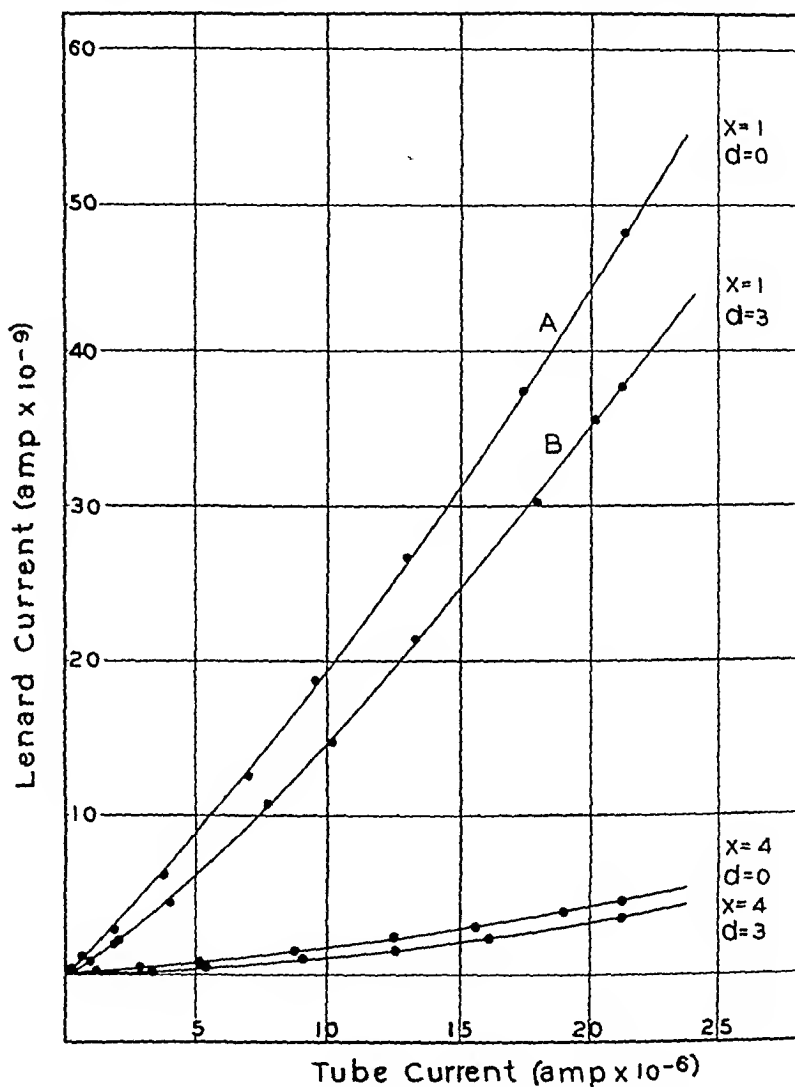


Fig. 10. Lenard current as a function of the tube current for the condenser collector. The ratio between Curves A and B is the same only for the same values of the tube current; x and d are indicated in centimeters.

ization intensity distribution will vary with both, it may then be safely assumed that the form of the curves in Figure 7 is not due to positive or negative ions.

The minimum always appears at d about 2 to 3 mm. and the saturation current is

may be explained as due to the fact that as the collector, F , recedes, the opening, O_2 , prevents electrons from striking it at the more grazing angles. The subsequent gradual approach to a complete Faraday current at $d = 20$ mm. is due to the gradual reduction

in scattering of electrons from the face of F to the edges of the opening, O_2 , or even entirely out through O_2 .

Figure 8 gives representative curves showing the current as a function of the

and, further, since it is found that the ratio of the two currents at any one value of d and any two values of x is the same for all tube currents, it is to be concluded that the ionization density in front of the collector,

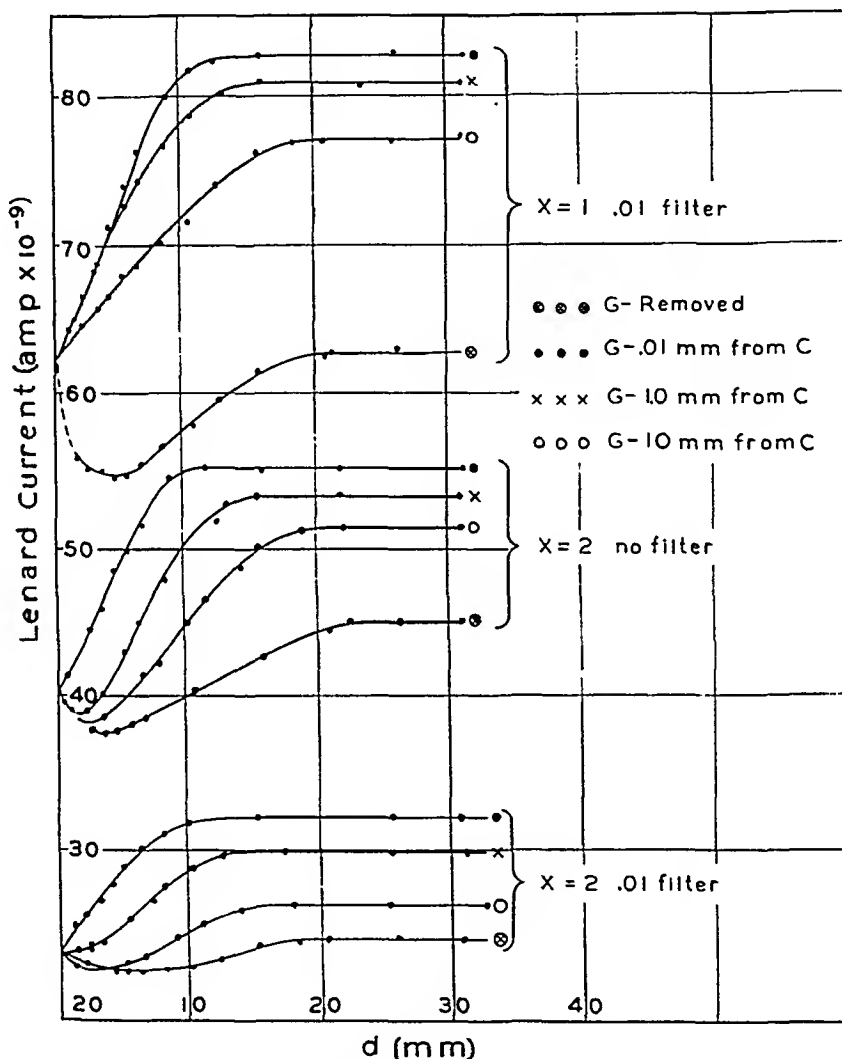


Fig. 11. Lenard current as a function of d for various filters and for various positions of the diaphragm G (Fig. 3).

Errata: In legend for "G-.01 mm. from C" (above) read "G-.027 mm. from C."

total tube current for four different distances, x (10, 20, 30, 40 mm.), from the tube window and two different distances, d (0, 30 mm.), of the collector plate, F , for each value of x . Since from these it is seen that the ratio of the two currents at any one value of x is the same for all tube currents;

which must change greatly over this range of conditions, does not affect the measured magnitudes. Curve A , taken for $d = 30$ mm., is seen to be about 33 per cent greater than Curve B , taken with $d = 0$, which is in good agreement with the curves shown in Figure 7.

We may conclude from these results that the open plate measurement of any Lenard current bears a constant ratio to the Faraday chamber measurement.

(5) Comparison of Condenser and Faraday Chamber Methods

To test the condenser method of Lenard-current measurement (Thaller), the opening, O_2 , was covered with a 0.01 mm. aluminum foil clamped in place by means of the ring, R (Fig. 3). The collector, F , was then moved back just sufficiently to prevent contact with the foil—about 0.02 mm.—forming a condenser with an air dielectric and having as plates the aluminum foil and the collector, F . As seen by Curve I in Figure 9 the Lenard current I_L for $d = 0.02$ mm. is very small but increases rapidly to a complete value several fold larger at $d = 20$ millimeters.

To reproduce Thaller's method more closely, the aluminum foil was backed with a mica sheet 0.015 mm. thick to serve as a solid dielectric in place of the air and the collector, F , then placed in close contact with the mica. Curve III in Figure 9 shows the Lenard current I_L as a function of d , whence it is seen that the complete value of I_L for this particular case is some 12 per cent lower than the plate ($d = 0$). It is also noticed that the intermediate current I_L passes through a minimum as in the case of the open Faraday chamber. Curve II taken with a 0.027 mm. layer of cellophane in place of the mica shows a similar curve—reaching a minimum and complete value for exactly the same values of d . It should be pointed out that the equal values of I at the minimum is accidental and in general will differ for different thicknesses of the dielectric. Also the ratio of plate to com-

plete value of I_L will vary with the dielectric thickness used.¹⁴

Contrary to the case of the open plate, the plate and complete currents are not linear functions of the tube current. Plotting, as in Figure 8, I_L against the total tube current (as the filament current is varied), the curves shown in Figure 10 are obtained; Curve A with $d = 0$ and Curve B with $d = 30$ millimeters. The ratio is found to vary but slightly as I_L increases. Compared, however, with the Faraday chamber or open plate method, the varying ratio eliminates the possibility of reliably determining Lenard currents by Thaller's method. This behavior is to be expected since, in the condenser method, electrons will pass through the dielectric at various angles, the absorption in the material will depend upon the degree to which the electrons have a velocity normal to the collector. This will vary with the ionization density in front of the tube, which, in turn, will vary with the tube emission.

(6) Effect of Changing the Dimensions of the Faraday Chamber

Before proceeding to a discussion of the form of the curves found above, it is of interest to investigate further the effect of the dimensions of the Faraday chamber upon the current measurements. Having found the effect of varying d , that of changing the position of the inner diaphragm, G (Fig. 3), with respect to the front cover, C , using two different qualities of Lenard radiation and two distances x between Lenard tube and Faraday chamber, was sought. The radiation quality was changed by placing a 0.01 mm. aluminum filter in the beam at distances of 3 and 13

¹⁴It might be mentioned that whereas a single sheet of mica has lasted throughout these experiments, cellophane turns yellow and becomes very fragile with a few hours' use at the current densities here employed. As a result a new sample was used for each set of observations, with the result that slight discrepancies exist between the curves.

mm., respectively, from O_2 , the corresponding positions of the chamber being $x = 10$ mm. and $x = 20$ mm., respectively. In both cases the current, I_L , to the Faraday cylinder was measured as a function of the

place. This is to be expected since a large number of the electrons scattered from the chamber will strike the outer grounded cover, C , and not become a part of the collector current except for the few rescattered

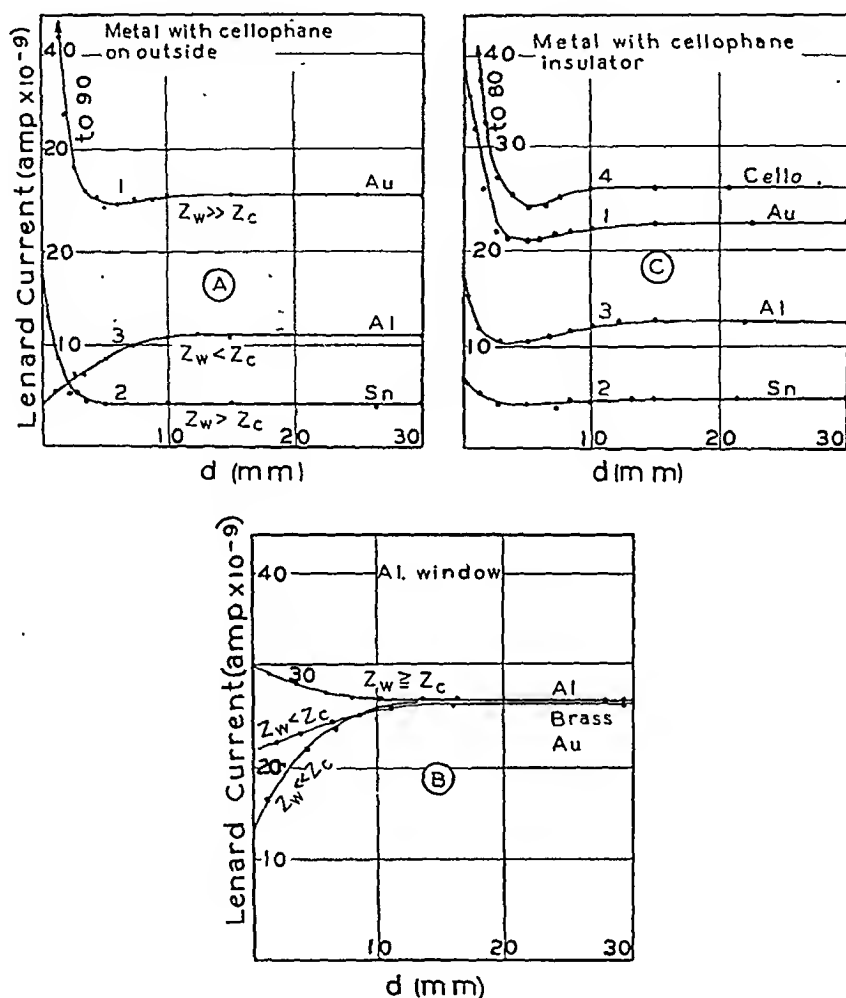


Fig. 12.

displacement d of the collector. The spacing between the plates G and C (Fig. 3) was made 10 mm., 1 mm., 0.027 mm. (held apart by a cellophane spacer near the periphery), and G removed entirely.

The resulting curves are given in Figure 11 and need little explanation. In all cases, the curves for G removed have a very much lower complete value than where it is in

to the wall, D , of the chamber. As the plate, G , is moved closer to C the complete currents increase in all cases, the maximum being for the 0.027 mm. spacing. With a chamber so constructed that all electrons incident over the plane of O_2 could enter the collector, the complete value would probably be slightly greater. Inspection also shows that the complete Faraday current point is reached

at successively smaller values of d as the spacing between C and G is decreased. This may be attributed to the fact that by decreasing the plate spacing, electrons are prevented from reaching the grounded case (including the beveled edges of O_2) and being lost.

III. EFFECT OF ELECTRON SCATTERING

The definite complete value of I_L , occurring always at the same value of d (for a given peak voltage and fixed dimensions of the chamber), would indicate that the electrons scattered from the face of F have a maximum velocity determinable from their range in air. Since the curves all reach the saturation at about $d = 15$ mm. we may conclude that this is the maximum range of the scattered electrons. (There will undoubtedly be scattered electrons having very nearly their initial velocity corresponding to about 150 kilovolts, but the quantity appears to be immeasurably small compared with the currents here used.) On the basis of Coolidge's data¹⁵ on the range of electrons in air, the maximum energy of the scattered electrons would be about 60 electron kilovolts.

Since the initial velocity of the greater part of the scattered electrons will be low, we find the greatest rate of change of I_L with d for small values of d . Thus, from the shape of the curve below the complete Faraday current point we might expect to obtain some idea of the velocity distribution in air of the backward scattered electrons, from which, in turn, could be determined the velocity distribution of the electrons in the initial beam, thus defining the quality of the beam.

The velocity distribution of the scattered electrons will, of course, depend upon the material of the collector, and the quantities actually measured will in addition depend upon the surrounding walls where rescatter-

ing occurs. Thus the quantity measured is the net result of a differential scattering. This is indicated by some of the curves in Figure 12, where I_L is plotted as a function of d . Group A was obtained using gold (atomic number $Z = 79$), tin ($Z = 50$), and aluminum ($Z = 13$) as thin covers over the opening, O_2 . These covers had different thicknesses and were themselves covered on the *outer* side by 0.027 mm. cellophane so that the absolute values of I_L are not comparable. The collector, F , was brass (Z about 30) as used heretofore. Electrons scattered from F are in part rescattered from and in part absorbed by the window.

Curve 1 for a gold window gives a very high plate current. Curve 2 for tin is similar in this respect though relatively smaller than for gold. Curve 3 for aluminum shows, on the other hand, a plate current lower than the complete current, and we find that in general when the atomic number, Z_w , of the window is greater than that, Z_c , of the collector the plate current is larger than the complete, and *vice versa*. This indicates that the net scattering reverses with the relative position of the scatterers in the atomic number scale.

To check this as it affects the type of measurements here involved, the curves in Group B were obtained, which seem to support this view. Here the window was of aluminum in all cases, while the face of the collector, F , was covered successively with aluminum, brass, and gold. The relative plate and complete values of I_L occur in an order which is the reverse of that shown by Curves A. The slight increase in the case of two aluminum scatterers may be attributed to a small amount of brass exposed by the beveled edges under the aluminum window.

With a cover of cellophane or mica over O_2 , the complete value of the current is less than the plate and hence does not obey the relationship to atomic numbers found for

¹⁵See Footnote 1.

the metal foils. Curve 4 in Group C, showing the variation of I_L with d , for a cellophane window over the Faraday chamber, is seen to give a higher plate than complete value for the current I_L .

Curves 1, 2, 3 show the effect of a cellophane insulator used behind a metal foil to form a window to the chamber. In all cases the plate currents are higher than the complete. In comparing these curves with those where the cellophane was on the outer side of the window (Fig. 12-*A*) it is seen that the complete currents are approximately the same. This again shows that Faraday chamber measurements bear a constant relationship to the current in the total beam irrespective of the nature of the material

through which the electrons pass in entering the chamber. The general form of the curves for the two conditions is the same only when the atomic number of the window is greater than that of the brass collector. In the case of an aluminum window backed with cellophane, however, the form of the curve for cellophane alone seems to predominate, the Curve C-3 appearing to be a combination of A-3 and C-4.

The author is indebted to Mr. C. F. Stoneburner, of this laboratory, who ably carried out all of the construction and measurements involved in this investigation. He is likewise indebted to Dr. W. D. Coolidge and to Dr. C. M. Slack, by whom the several cathode-ray tubes were loaned.

A SIMPLE METHOD FOR CALCULATING DOSES WITH MULTIPLE POINTS OF GAMMA RADIATION

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THE measurements and calculations in this paper were made in an endeavor to arrive at a simple method of determining a suitable distribution, dosage, and intensity at depth for radium or radon tubes when used with Columbia paste packs. The work of Quimby¹ along these lines suggested this work.

Two methods were used, photographic and ionization measurements.

(1) *Photographic.*—Films were exposed to determine the arrangement of tubes at various distances which would radiate uniformly a given area. From the results of these exposures the following conclusions were drawn:

(a) Most conditions will be satisfied by the three arrangements of tubes shown in Figure 1.

(b) At 1 cm. distance the maximum spacing between parallel tubes should be 1 cm., center to center. When in tandem, the tubes should touch, end to end.

(c) At 2 cm. distance the maximum spacing between parallel tubes should be 2 cm., center to center, and tandem tubes should touch.

(d) At greater distances than 2 cm., greater spacing between parallel tubes would not be satisfactory because at these greater distances the intensity at the skin would be reduced to such an extent as to make it advisable to use more radium, in order to shorten the treatment.

2. *Ionization Measurements.*—The experimental arrangement of electroscope, ion-

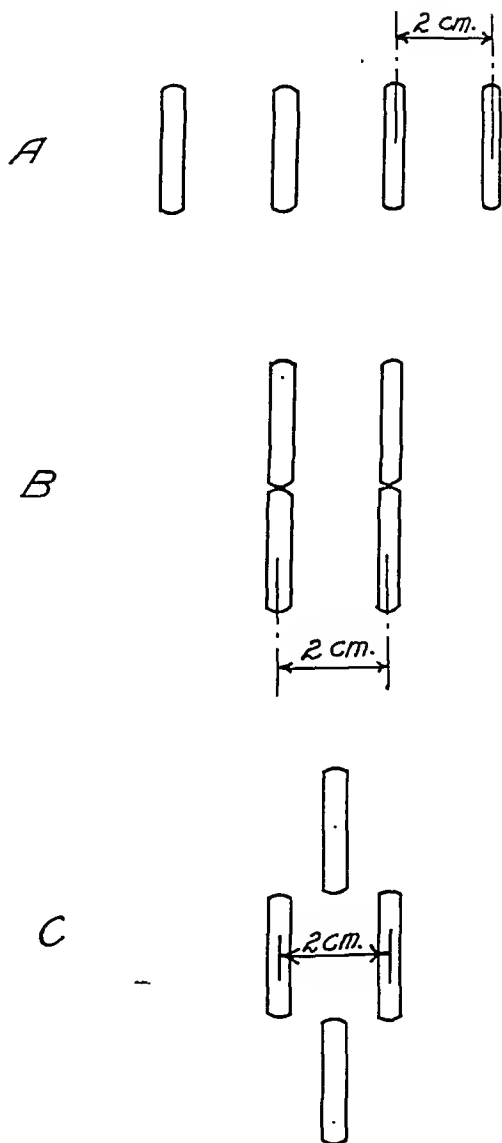


Fig. 1. Three arrangements of tubes.

ization chamber, and radium is shown in the accompanying diagram. (Fig. 2.)

¹Quimby, Edith H.: Effect of Size of Radium Applicators on Skin Doses. Am. Jour. Roentgenol., October, 1922, IX, 671-683.

The electroscope was in a separate room, insulated by one-eighth inch lead, and the radium to be measured was in the adjoining room. The electroscope was so placed as to be in the direct shadow of a lead block 8 by

tain the desired distance. The radium tube was 21.5 mm. long, 4 mm. outside diameter, having a wall thickness of 1 mm. platinum. The results of these measurements are shown as an isodose curve in Figure 3. The

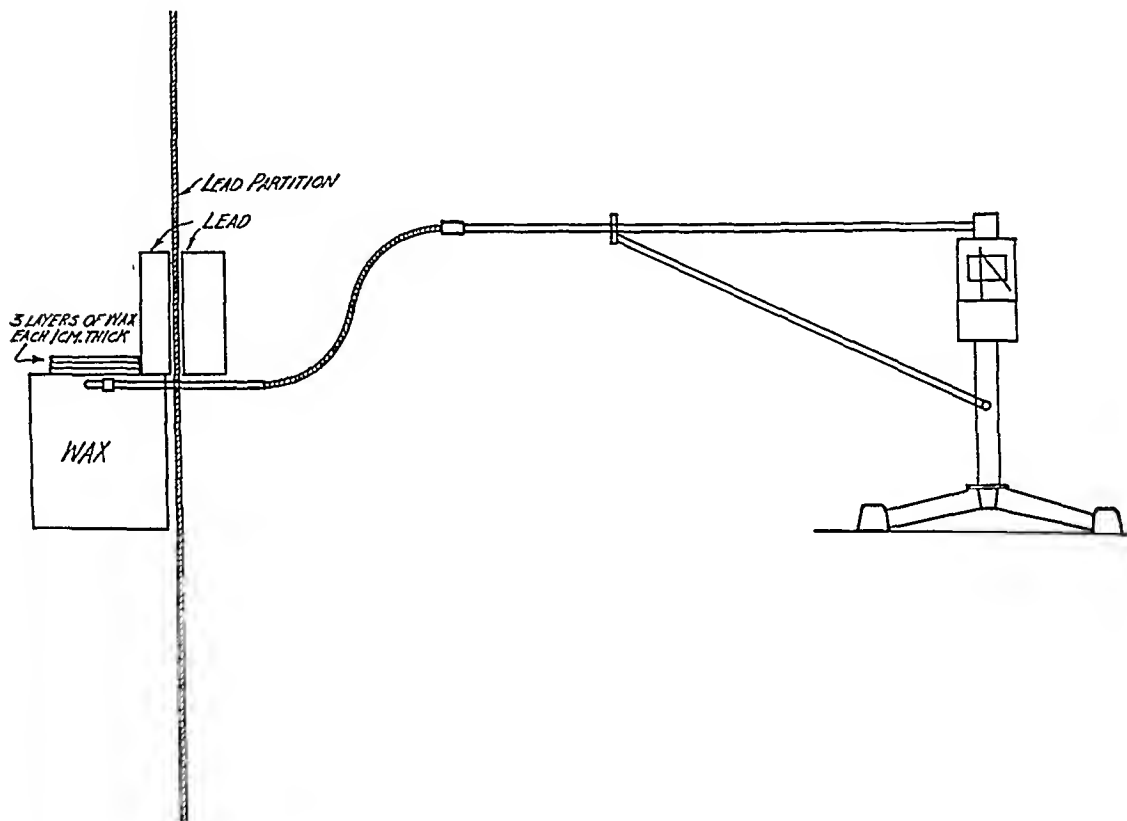


Fig. 2. Diagram showing the experimental arrangement of electroscope, ionization chamber, and radium.

10 by 4 inches thick. With this arrangement the leakage was so small that the discharge readings were not affected. The ionization chamber was made of bakelite impregnated with graphite, and had an outside diameter of 9 mm. and a wall thickness of 0.25 millimeter.

The intensity around a single radium tube was measured, at distances 1, 2, 3, 4, 5, 6, 8, 10, and 12 cm. from the center of the ionization chamber to the center of the radium tube. Wax spacers were used to ob-

tain perfect semicircles are probably not maintained near the surface, due to scattering. These same values are shown in another form in Figure 4. This curve, drawn to a much larger scale than shown here, was used to calculate the intensities from various tubes at various distances, in the following manner.

Four points, representing the midpoint of four parallel tubes, were placed 2 cm. apart and 2 cm. away from a line representing the skin. A point *R* (see Fig. 5) on this line

was chosen as being the center of the field. The distances from each tube to this point were carefully measured and the intensities corresponding to these distances were then read on Figure 4. Thus the intensity at point *R* was the sum of the intensities contributed by the four tubes, or 70.4 per cent

Tube	Distance from Skin	Intensity at <i>P</i>
1	d 2.82 cm.	16.0 per cent
2	c 2.0 cm.	30.0 per cent
3	d' 2.82 cm.	16.0 per cent
4	e 3.18 cm.	7.0 per cent
		<hr/> 69.0 per cent

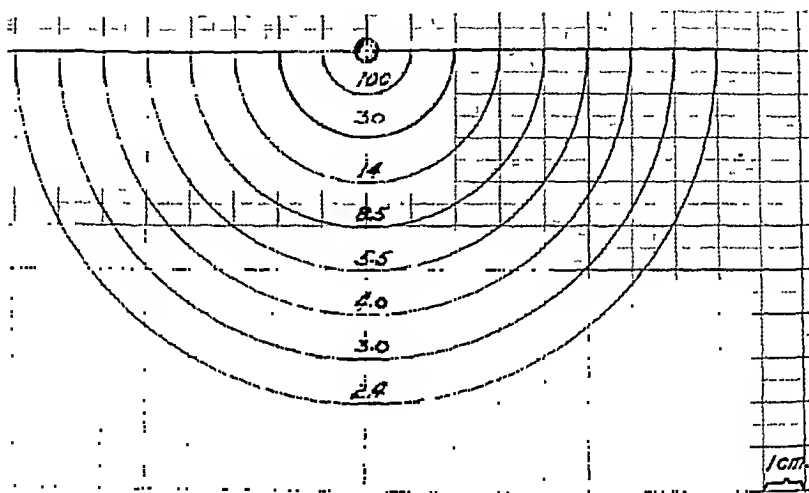


Fig. 3. Isodose curve. See text.

of the intensity applied 2 cm. above the skin. The actual measurements and values are given below.

Tube	Distance from Skin	Intensity at <i>R</i>
1	b 3.63 cm.	10.2 per cent
2	a 2.24 cm.	25.0 per cent
3	a' 2.24 cm.	25.0 per cent
4	b' 3.63 cm.	10.2 per cent
		<hr/> 70.4 per cent

There was a possibility that a point directly under one of the tubes would have a greater intensity than the point chosen in the center of the field, therefore point *P* was selected and the intensity determined as before.

The close agreement between 70.4 per cent in the center of the field and 69.0 per cent 1 cm. on either side proves that there is no so-called "hot spot," and bears out the photographic findings that radium spaced 2 cm. apart at 2 cm. distance from the skin radiates uniformly.

The same procedure was followed in determining the intensity at a point *S* 1 cm. below the skin.

Tube	Distance from Skin	Intensity at <i>S</i>
1	d' 3.18 cm.	13.0 per cent
2	c' 4.26 cm.	7.6 per cent
3	c 4.26 cm.	7.6 per cent
4	d 3.17 cm.	13.0 per cent
		<hr/> 41.2 per cent

The ratio 70.4 : 41.2 :: 100 : *X*
X = 58.5 per cent

Therefore, if 100 per cent is given to the surface instead of 70.4 per cent, then at 1 cm. below the surface there will be an intensity of 58.5 per cent.

Following this method, intensities were calculated for 1-8 parallel tubes separated 1 cm., and for 1-14 parallel tubes separated 2 cm., at radium skin distances of from 2 to 6 centimeters. Plotting these intensity figures, smooth curves were drawn for each combination of tubes at the various distances, to eliminate some slight irregularities. The values obtained from these curves were then converted into factors, using the intensity at 1 cm. with one tube as unity. By means of these factors, the intensity for any combination could be converted to 100 per cent at any given distance. These dosage factors are compiled in Table I. In order to use this tabulation it is first necessary to determine or select a suitable erythema

skin dose with one tube at 1 cm. distance from the skin. This chosen dose, multiplied by the factor for any combination of tubes at any particular distance, will give the S.E.D. for that combination and distance. Table II shows such a calculation using 300 mg.-hr. as an arbitrary skin dose at 1 centimeter.

Obviously it was not feasible to use this method of calculation for tubes arranged in tandem in parallel rows. Instead, we were forced to rely on ionization measurements only. We found, however, that the same conditions exist when more than two tubes are arranged in tandem and parallel as when the same number of tubes are arranged in parallel only. Table III gives the values obtained from measurements of four tubes in parallel (see Fig. 1-A) 2 cm. apart and 2 cm. Ra-S.D., and four tubes in tandem and parallel (see Fig. 1-B) as compared with

TABLE I.—FACTORS TO BE MULTIPLIED BY S.E.D. WITH ONE TUBE AT 1 CM. IN ORDER TO DETERMINE ERYTHEMA DOSES WITH VARIOUS NUMBERS OF TUBES AT VARIOUS DISTANCES

Parallel tubes 1 cm. apart²

Ra-S.D. (cm.)	Number of tubes						
	1	2	3	4	5	6	8
1	1.00	1.14	1.38	1.61	1.88	2.20	2.63
2	3.33	3.50	3.87	4.10	4.45	5.10	5.70
3	7.15	7.26	7.40	7.65	8.30	8.90	9.50

Parallel tubes 2 cm. apart³

Ra-S.D. (cm.)	Number of tubes								
	1	2	3	4	6	8	10	14	16
2	3.33	3.93	4.80	5.57	7.38	9.18	11.0	15.0	17.0
3	7.15	7.32	8.27	9.40	12.0	14.0	16.6	22.0	
4	11.8	12.0	13.25	14.5	17.7	20.4	23.5	30.7	
5	18.0	18.0	19.45	20.6	24.1	27.4	31.3	40.0	
6	25.0	25.1	26.5	27.8	31.4	35.0	39.5	50.0	

In order to obtain the factors at greater distances than 3 cm., when the tubes are spaced 1 cm. apart, use the factors in the lower half of the table under parallel tubes 2 cm. apart with half the number of tubes. e.g., for Ra-S.D. 4 cm., 6 tubes spaced 1 cm. apart, use the factor under tubes spaced 2 cm. apart column headed 3 tubes, Ra-S.D. 4 centimeters.

²Approximate area at 1 cm. Ra-S.D. is 4 sq. cm. per tube. At greater distances the area becomes progressively greater.
³Approximate area at 2 cm. Ra-S.D. is 8 sq. cm. per tube. At greater distances the area becomes progressively greater.

TABLE II.—ERYTHEMA DOSES CALCULATED FROM FACTORS (TABLE I)
Parallel tubes 1 cm. apart

Number of tubes							
Ra-S.D.	1	2	3	4	5	6	8
(cm.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)
1	300	342	414	482	565	660	790
2	1,000	1,050	1,160	1,230	1,330	1,530	1,710
3	2,140	2,170	2,220	2,290	2,480	2,670	2,850

Parallel tubes 2 cm. apart

Number of tubes								
Ra-S.D.	1	2	3	4	6	8	10	14
(cm.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)
2	1,000	1,150	1,440	1,665	2,210	2,750	3,300	4,500
3	2,140	2,200	2,470	2,820	3,600	4,200	4,970	6,600
4	3,540	3,600	3,970	4,350	5,300	6,100	7,050	9,200
5	5,400	5,400	5,820	6,180	7,220	8,200	9,400	12,000
6	7,500	7,500	7,950	8,350	9,400	10,500	11,420	15,000

TABLE III

Depth	Measured values		Calculated values
	Tandem and parallel	Parallel	Parallel
2 cm.	100 per cent	100 per cent	100 per cent
3 cm.	60.8 per cent	60.0 per cent	59.0 per cent
4 cm.	38.7 per cent	39.0 per cent	38.4 per cent
5 cm.	26.9 per cent	27.8 per cent	27.0 per cent

TABLE IV.—DEPTH INTENSITIES

For 1 cm. Ra-S.D. Only					Tubes 1 cm. Apart			
No. of tubes	1	2	3	4	5	6	7	8
Depth (cm.)								
0	100%	100%	100%	100%	100%	100%	100%	100%
1	30.0	32.5	35.6	39.3	42.2	43.5	45.7	46.3
2	14.0	16.5	18.5	21.0	22.6	24.9	26.0	27.6
3	8.5	9.6	11.0	12.9	14.3	15.7	17.2	18.1
4	5.5	6.4	7.5	9.0	9.8	11.0	11.8	12.5
5	4.0	4.8	5.3	7.0	7.5	8.2	8.7	9.3

calculated values for four tubes in parallel (see Fig. 1-A).

Since wax has approximately the same absorption for gamma radiation as tissue

and was used in the ionization measurements from which the curve in Figure 4 was made, it is therefore permissible to use this curve to determine depth dosage. The meth-

od used in determining dosage factors as outlined in Figure 5 was repeated in order to determine the intensities at depth. Tables IV and V show the intensity at different dis-

the depth doses will be found on Table V, Ra-S.D. of 4 cm. with four tubes.

A departure from 1 mm. platinum filtration need not invalidate these charts, pro-

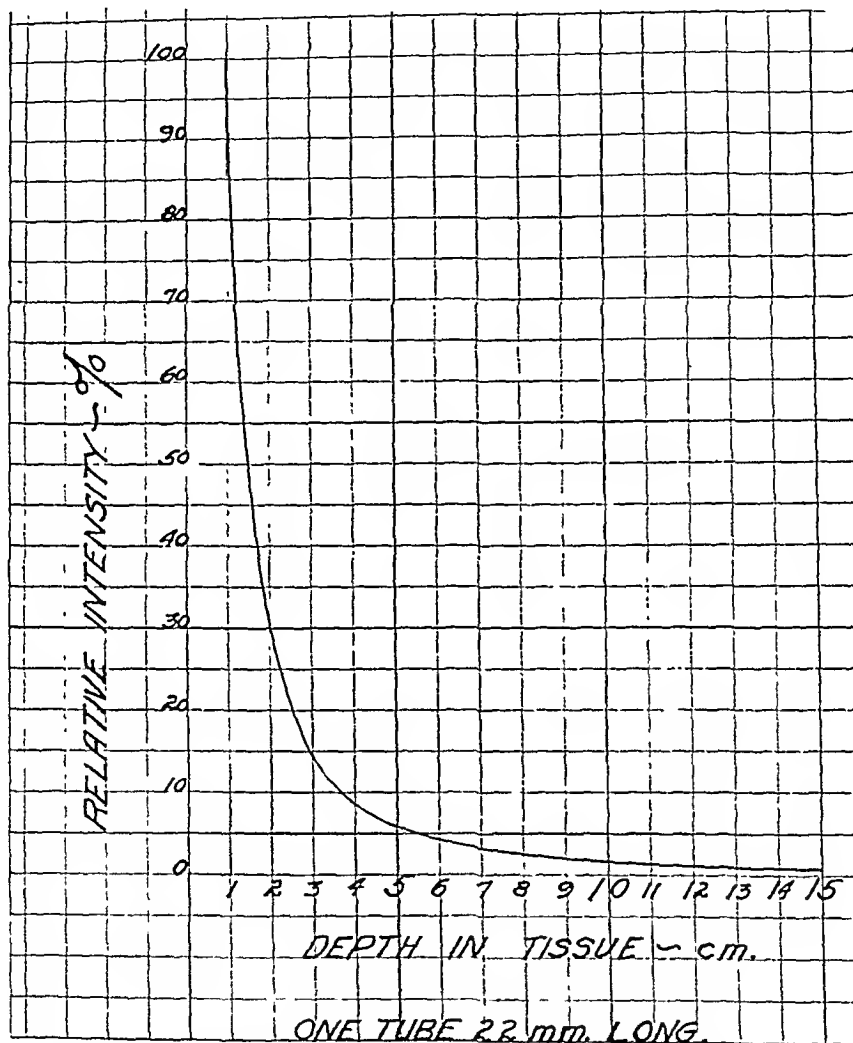


Fig. 4. This curve, drawn to a much larger scale than shown here, was used to calculate the intensities from various tubes at various distances.

tances below the skin, when the radium skin distance varies from 1 to 6 centimeters.

For greater radium-skin distances (Ra-S.D.) use depth charts, Table V as with half the number of tubes, i.e., for a Ra-S.D. of 4 cm. with eight tubes separated 1 cm.,

vided the filtration is sufficient to insure pure gamma radiation. Should the radium tubes be slightly longer or shorter than the ones used in these experiments, the surface and depth intensities would vary slightly from the values given.

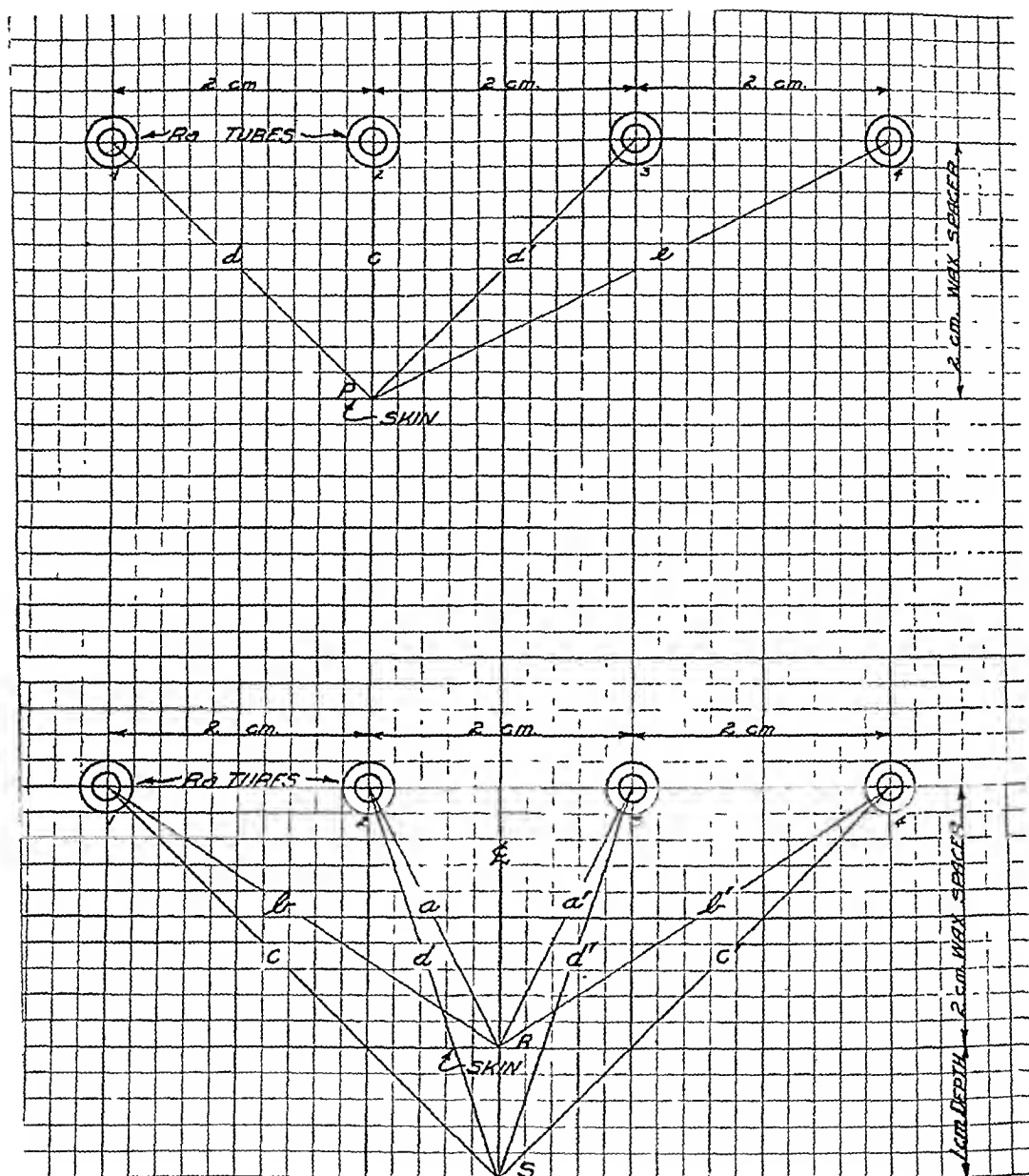


Fig 5. Four points represent the midpoint of four parallel tubes placed 2 cm. apart and 2 cm. away from a line representing the skin.

SUMMARY

A photographic method is described which determines an even distribution of

radiation if radium is spaced not more than 1 cm. apart at 1 cm. Ra-S.D. or not more than 2 cm. apart at 2 cm. Ra-S.D. At greater radium-skin distances the tubes are

TABLE V.—DEPTH INTENSITIES

One tube						Two tubes, 2 cm. apart					
Ra-S.D.	2 cm.	3 cm.	4 cm.	5 cm.	6 cm.	Ra-S.D.	2 cm.	3 cm.	4 cm.	5 cm.	6 cm.
Depth						Depth					
0 cm.	100 %	100 %	100 %	100 %	100 %	0 cm.	100 %	100 %	100 %	100 %	100 %
1	46.6	60.8	65.2	72.5	75.0	1	53.7	61.0	66.8	72.0	74.5
2	28.3	39.7	47.5	54.2	61.2	2	32.6	40.8	48.4	53.6	59.9
3	18.5	28.7	35.4	44.4	50.0	3	21.8	29.3	35.9	43.1	48.4
4	13.4	21.5	29.0	36.3	42.5	4	15.7	21.8	28.8	34.9	39.5
5	10.0	17.6	23.7	30.8	33.6	5	11.7	17.6	23.3	28.4	32.5
6	8.2	14.4	20.2	24.3	29.8	6	9.4	14.2	19.0	23.4	29.9

Four tubes, 2 cm. apart						Six tubes, 2 cm. apart					
Ra-S.D.	2 cm.	3 cm.	4 cm.	5 cm.	6 cm.	Ra-S.D.	2 cm.	3 cm.	4 cm.	5 cm.	6 cm.
Depth						Depth					
0 cm.	100 %	100 %	100 %	100 %	100 %	0 cm.	100 %	100 %	100 %	100 %	100 %
1	59.0	65.0	70.3	74.0	76.5	1	61.7	67.6	73.4	76.6	77.5
2	38.4	45.8	52.2	56.7	61.0	2	41.7	49.6	56.4	59.4	62.5
3	27.0	33.9	39.8	45.2	50.0	3	30.6	38.1	43.7	48.0	51.9
4	20.0	25.9	31.8	37.2	41.0	4	23.5	29.5	35.3	39.8	43.4
5	15.3	20.7	26.1	30.4	38.5	5	18.2	23.8	29.2	33.3	36.6
6	12.2	17.0	21.4	25.6	30.5	6	14.7	19.8	24.4	28.1	31.9

Eight tubes, 2 cm. apart						Ten tubes, 2 cm. apart					
Ra-S.D.	2 cm.	3 cm.	4 cm.	5 cm.	6 cm.	Ra-S.D.	2 cm.	3 cm.	4 cm.	5 cm.	6 cm.
Depth						Depth					
0 cm.	100 %	100 %	100 %	100 %	100 %	0 cm.	100 %	100 %	100 %	100 %	100 %
1	65.1	69.2	74.4	77.6	78.2	1	66.3	70.2	75.4	79.0	81.0
2	45.0	51.5	58.2	61.2	63.0	2	46.7	58.1	59.6	63.9	66.6
3	33.5	40.3	45.5	49.2	52.3	3	35.2	41.0	48.4	52.6	55.8
4	26.2	31.5	36.7	40.9	44.3	4	27.8	33.9	39.6	44.0	48.2
5	20.5	25.7	30.5	34.6	38.5	5	22.5	27.8	33.2	38.1	41.4
6	16.5	21.0	25.8	30.2	34.0	6	19.5	23.4	28.7	32.7	36.5

Fourteen tubes, 2 cm. apart					
Ra-S.D.	2 cm.	3 cm.	4 cm.	5 cm.	6 cm.
Depth					
0 cm.	100 %	100 %	100 %	100 %	100 %
1	68.2	71.8	76.4	80.3	82.0
2	49.0	54.8	61.2	65.8	68.7
3	37.4	44.0	50.2	55.1	58.4
4	30.0	36.1	42.0	46.0	50.0
5	24.6	30.2	35.7	40.1	43.3
6	20.6	25.6	30.6	34.8	38.0

still spaced 2 cm. apart. A method which may be used to calculate depth doses at various Ra-S.D. is described and compared with measured values for the same. Tab-

ulations are given to be used in determining dosage with multiple points of radiation and intensity of radiation at different distances below the points of application.

RADIOTHERAPY WITH SMALL QUANTITIES OF RADIUM

By PAUL O. SNOKE, M.D., LANCASTER, PENNSYLVANIA

THE premise that large quantities of radium are essential to adequate therapy has gained wide acceptance. A perusal of the radiological literature creates the general impression that adequate radium therapy demands one-half gram of radium or more (the more the better), and that the use of smaller quantities in the treatment of malignancy is blameworthy and absurd. Credence has been lent to this assumption by the publication of reports from cancer centers where unusually large quantities of radium are in use.

If, however, we delve into the problem more deeply we find that excellent work can be accomplished with small quantities, and that the amount of radium necessary is dependent only upon the clinical material available. It is with this in mind that we venture this presentation.

Attempts to discover the geographic quantitative distribution of radium in the United States were ineffectual. No reliable figures are available, but in a general way we learned that approximately 75 grams of radium are now in the hands of the medical profession in this country. Saltzstein (2), in an article published in 1929, says, "In only three cities . . . were there larger amounts of radium than 100 and occasionally 200 milligrams." This statement was written after he had visited twenty cities, ranging in population from 100,000 to 1,250,000, five of which cities have medical schools.

It is evident that the quantity of radium available in many cities is far less than many physicians believe. The obvious paucity of the element renders such excellent scientific work as Duffy's (1), of only slight practical point, therefore, to the vast majority of the practising radiologists, with the exception, that purely scientific investigation

may point the way for the ingenious, radium-poor therapist to adapt scientific fact to practical problems. Obviously there is a great gulf fixed between radium therapy in twenty cities of the United States and in the several large scientific investigative centers. The bridging of this fixed gulf is most difficult, involving many factors.

When radium first became available as a therapeutic agent the surgeon saw his need for it, felt his responsibility to his patients, and, as he possessed the necessary capital, began its use. Little opportunity was afforded him for training in this field. Up to 1915, only twenty-three papers on radium therapy of carcinoma of the cervix had appeared in the world's literature and of these only seven were prepared by American physicians. In the three succeeding years little could be done because of the War, so that not much over a decade of active work has resulted. Meanwhile, the surgeons were bearing the brunt of the attack upon cancer, and contributing largely to scientific radiologic knowledge. We need only mention the names of Kelly, Janeway, Perthes, and Döderlein. On the other hand, the vast majority of the surgeons were using radium as a stop-gap in cases in which further surgery was impossible. The past decade has witnessed an adjustment of this deficiency, and now there are well-trained radiologists. The burden of the work of the next decade must fall upon these men, for they must adapt scientific fact to practical exigency.

THE LOCAL PROBLEM

The Lancaster General Hospital is a community hospital containing 225 beds, serving an urban population of 60,000, with a surrounding farming community of 250,000. Approximately a hundred physicians serve

these people. There is also another hospital of almost equal size in this city, and only sixty miles distant is a city of the first class.

By consulting the records of the Bureau of Health of the State of Pennsylvania, we ascertained that in 1928 there were 228 deaths from cancer in Lancaster County. Assuming that this represented one-third of the morbidity, it would mean that at any particular moment there were 680 persons suffering from cancer in this area. This morbidity figure (3) is open to grave question, as cancer is not a reportable disease, and, therefore, few figures are available. Hoffman (4) makes no statement concerning this matter.

We believe the assumption that the mortality from cancer is one-third of the morbidity is incorrect, erring on the high side for the following reasons: During the year 1928 there were 104 cases of cancer admitted to the Lancaster General Hospital, practically all of which were major surgical cases. During the same period 40 other cases were seen in the radiological department. Only about 50 per cent of the work in this community is taken care of by this hospital. It is a simple matter to compute from these figures the estimated 680 cases, forgetting those patients refusing hospitalization, treated by private physicians, hiding their disease, or incorrectly diagnosed.

Using the morbidity figure 680 as the sole available one, it is only fair to assume that 50 per cent of this group will be taken care of by one of the two city hospitals. If 50 per cent of the remaining patients apportioned to this hospital are untreatable by radium, we could expect to build about a group of 170 patients per year. It may be objected that 50 per cent is too high a figure for radium-irradiable patients. Nevertheless, many other diseases require radium therapy which can not be classified as cancer, such as the leukemias, angioma and skin diseases. Of this group, about 5 per cent (*i.e.*, the wealthy) will go elsewhere.

The income from the remaining 162 prospective patients must meet the interest on the investment, the insurance, and a reasonable salary to those handling the treatment.

The fixed charges are the interest on the initial radium investment of \$5,500 at 6 per cent, amounting to \$318 annually, and the insurance, which is approximately 2 per cent of the investment, or \$118. The insurance is a very necessary item, as the risk of loss is great. There are two forms of insurance: the form referred to here has the "supervision clause," requiring the supervision of a trained nurse during the use of the radium. This is the least expensive form; besides, the supervision of a nurse is advantageous from the radiologist's viewpoint, assuring him of accuracy in timing and positioning.

No depreciation is charged against this account, as the element has a half-life of 1,860 years. The applicators must be counted as an expense, but this item is not large, amounting to less than \$30 per annum. This gives us total fixed charges of \$466 per annum.

DISTRIBUTION OF RADIUM IN ORIGINAL CONTAINERS

In order to be of the greatest service, the radium must be in its most flexible form. Needless to say, a radium emanation plant is impracticable with smaller quantities of radium than one-half gram. Predicating the use of the element, two main methods of treatment must be made available:

- (1) Interstitial radiation
- (2) External application

We must, therefore, have needles and capsules.

With the funds available¹ we could purchase 75 milligrams of radium. It was decided to secure five 10-mg. steel needles and one 25-mg. capsule. The needles were secured for interstitial radiation; also, after

¹Made available through the courtesy of Dr. H. B. Davis.

enclosure in a brass capsule, for cervical or surface applications. The 25-mg. capsule was especially desired for enclosure in 0.5 mm. of Ag for surface application; also for use in a 1 or 2 mm. brass capsule for cervical or surface application.

Since this acquisition the work of Regaud (5) has been studied and we feel that better results can be obtained with greater filtration; so that we contemplate changing our five 10-mg. needles for ten 2-mg. platinum-iridium needles. This will release 25 milligrams for applicators.

TYPES OF CASES TREATABLE

There are several principles which must be firmly grasped before any therapy is undertaken. The patient must be made to understand that radiation therapy requires time—it is not a pill to be taken and forgotten. Cancer therapy is a matter of a week or more and the beneficial effects may not occur for months. Time is the cheapest thing the patient has to invest. The duration of treatment from the patient's viewpoint should be an inconsequential matter; it is to the therapist that the time factor is important. At the Curie Institute, in Paris, one month is required for the completion of a radiation cycle for carcinoma of the cervix.

Very little beta radiation is used in our work, preference being given to filtrations through 1 mm. brass, 2 mm. brass, or 3 mm. lead. The higher filtrations require longer treatment times. The highest filtration we use is 3.0 mm. of lead. Moulages of Columbia paste or dental compound are very advantageous.

Interstitial radiation finds its greatest use in intra-oral lesions, carcinoma of the breast (in cases in which operation is contra-indicated or impossible), and occasionally in carcinoma of the cervix.

Surface radiation is used more than any other method. Lesions in the intra-oral group can be irradiated by the application

of capsules on variously shaped handles fashioned from lead sheeting 2.0 mm. thick. A lead spoon may be used for applications to the hard palate, while the ordinary tonsil clamp can be used in carcinoma of the tonsil. Carcinomatous lesions of the skin are well fitted for this type of radiation, the silver tube being used for the more superficial types. In the more infiltrating types, distances up to 2.5 cm. are employed, obtained by cutting corks to the size and thickness desired. The exact technical details will be found in a later article.² The patient is usually hospitalized for three days if a large area is to be treated; for example, in the treatment of carcinoma of the thyroid fourteen areas are usually treated, the time required being 42 hours.

Carcinoma of the cervix uteri probably represents the most frequently irradiated site and the most ideal one for this type of work. The brass capsules are used for the intra-cervical applications and the technic of Bowing (6) followed with minor modifications. The results are not in direct proportion to the quantity of radium used, but depend upon the wisdom of the radiologist, and his technic. A great deal of attention is given to the accurate measurement of lesions, or the drawing of them to scale and planning on these drawings the various fields to be treated. Photographs and biopsy records are kept of each patient, so that at any time a complete record is at hand. Notes of the progress of the case are made at frequent intervals and are of great importance in case reviews.

CONCLUSIONS

Radiotherapeutic results depend upon the training and ingeniousness of the radiologist, and not entirely upon the quantity of radium available. The radium requirements of any institution or community can be determined within the limits of financial safe-

²A second paper, on technic, will be published soon.

ty by a consideration of the factors involved. It is neither practical nor necessary that large quantities of radium should be available, for the mere possession of a half-gram of radium is no guarantee that the patient will receive sufficient treatment.

An adequately trained radiologist is more to be desired than radium, yea, than much fine radium, if you will pardon a paraphrase. The effectual use of radium demands the supervision of one man so trained; unless this is done, therapy is a haphazard matter, without definite beginning or ending, and efficiency in the use of the element is impractical, for radium should work twenty-four hours each day when the clinical material is available. It is not to be expected that the surgeon will meet in his practice those patients with skin diseases amenable to radium therapy, nor will he see the blood dyscrasias which perplex the internist; but the respective specialists will each know those diseases in his field which are suitable for radium irradiation—the surgeon his sarcomas, the gynecologist

his carcinomas of the cervix, the internist his leukemias, the dermatologist his hemangiomas. The radiologist, drawing from these sources, finds daily use for his radium, and knows the multiplicity of technical details so essential to successful treatment.

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RADIOTHERAPY IN CHRONIC MYELOGENOUS LEUKEMIA¹

By ROY G. GILES, A.B., M.D., TEMPLE, TEXAS

LEUKEMIA has presented many interesting and perplexing problems since the independent account of this malady by John Hughes Bennett (1) and Rudolph Virchow (32) in 1845. Chronic myelogenous leukemia is a disease of the blood-forming tissues, of unknown origin, the characteristic findings of which are: a great increase in the white cells; an increase in the pathological cells, especially the myelocytes in the circulating blood, and a secondary anemia, accompanied by varying degrees of splenic and glandular enlargement.

The majority of cases of chronic myelogenous leukemia, 55 per cent, according to Minot (16), occur between the ages of thirty and fifty years. There is a sharp drop in the incidence of the disease after the age of sixty; however, occasional cases are reported in elderly persons. Ordway and Gorham (18) observed chronic myelogenous leukemia in a woman seventy-five years of age. It is a rare malady before the sixth year, but there are several carefully studied cases of myelogenous leukemia in infants. Up to 1925, Steinbrink (28) had noted only 33 cases in young individuals. In 1927, Ramsay (23) analyzed 19 cases in infants.

The therapeutic measures for the treatment of leukemia were, for the most part, symptomatic and directed against the associated anemia until relatively recent years, when it was discovered empirically that certain agents have a more or less specific effect in reducing the greatly increased number of white cells. Therefore, modern treatment is directed not only toward the secondary anemia, but toward the leukemia.

The general management of patients suf-

fering with chronic leukemia should include the best possible hygiene, outdoor life with its fresh air and sunlight, and exercise regulated to the strength of the individual patient. The diet should be adjusted to the requirements of the patient, consisting in many cases chiefly of fruits, vegetables, and milk. Physiotherapy, especially in the form of tonic ultra-violet ray, may exert a beneficial influence on the general well-being of the patient. We should not neglect medicinal measures such as iron and arsenic in their various forms. Transfusions, red bone marrow, and colloidal metals have been advocated.

Spontaneous remissions occur normally but rarely in chronic myelogenous leukemia. Minot, Buckman, and Isaacs (16) observed definite spontaneous moderate remissions in 7.7 per cent of 52 non-irradiated cases. Untreated cases are slowly progressive, and usually have a slow downfall, though the patient may remain for a long time in a poor state of health. The measures which have been directed toward the treatment of leukemia are splenectomy, benzol, roentgen ray, radium, thorium, and some of the other radio-active preparations. These remedies have been used to bring about remissions in the chronic type of the disease, but acute leukemia is apparently influenced very little, if at all, by any type of treatment.

Splenectomy was the first measure directed toward the treatment of leukemia. The first case of removal of the spleen for myelogenous leukemia was reported by Bryant (3) in 1866. The patient, who had a very large spleen, was in poor general condition and died soon after the operation. Giffin (9b) states splenectomies were performed, not infrequently, during the period from 1866 to 1900. According to him, the

¹Read before the Radiological Society of North America, at the Sixteenth Annual Meeting at Los Angeles, Dec. 1-5, 1930.

total number reported in the literature to January 1, 1918, is 51, with temporary recovery in eight cases. This indicates an operative mortality of 86 per cent.

W. J. Mayo (15c) reports they have found that, after the size of the spleen has been reduced by radium or X-rays, a splenectomy can be performed with comparatively little risk. During the period from April 1, 1904, to March 1, 1928, Mayo reported that splenectomies were performed in 500 cases, with a mortality rate of 10 per cent. Of these 500 cases, 45 had the spleen removed for myelogenous leukemia, with an operative mortality of only 6.6 per cent. Radium or X-rays were used prior to the operation to reduce the white count and the size of the spleen. The mortality rate was lower in the cases of myelogenous leukemia prepared by radium or X-rays before the removal of the spleen than the average for splenectomy in general.

Giffin (9b) states:

Patients who have had the disease apparently less than a year, and especially less than six months, and do not show any evidence of acute exacerbations, can be promised prolongation of life, and better general health, with a fair degree of confidence.

He sums up the status of removal of the spleen as follows (9b, 9c): "It is thus concluded that splenectomy is warranted in certain cases of myelogenous leukemia, though it is not to be urged." Norris and Farley (17) believe that the only reason for surgery is removal of the spleen to relieve weight and pressure. Removal of the spleen does not alter the course of the disease, since the blood formula remains qualitatively leukemic following splenectomy. It is a measure, therefore, to be used only in the exceptional case.

According to Miller (15d), Santassen, in 1897, first noticed that there was a reduction in the total leukocyte count, with a corre-

sponding reduction of red blood cells, in persons using benzol in a bicycle factory. The leukotoxic action of benzol was confirmed in 1910 by Selling (26). This action suggested its use in leukemia, the first practical application being made by Koranyi (12) in 1912, with a marked reduction in the blood picture. Benzol is a specific bone poison, affecting the cells that produce the red corpuscles, as well as those producing the leukocytes, thus causing an increase in the associated anemia. In addition, benzol is markedly toxic, producing disagreeable symptoms, occasionally followed by sudden death. Therefore, it is not used to any great extent at the present time in the treatment of leukemia.

Senn (27), in 1903, first undertook the treatment of leukemia by means of the X-rays. Pancoast (20), Roth (25), Renon, Degrais and Desbouis (24), Ordway (19), Peabody (21), Giffin (9a), Vogel (33), Wood (35), Levin (14), Oppenheimer (22), Stern (29), Gulland (11) and others were among the early observers to point out the dramatic drop in the white blood cells when a case of myelogenous leukemia was treated with X-rays or radium. It was not until Renon, Degrais, and Desbouis (24), in 1913, and Peabody (21) and Ordway (19), in 1917, reported the effect of radium on the disease that adequate irradiation was given at sufficiently frequent intervals to produce marked alleviation of symptoms.

The action of roentgen and (16b) radium rays upon the normal circulating blood consists of an initial leukocytosis bearing chiefly on the polymorphonuclear cells. The leukocytosis lasts for from a few hours to two or three days and is followed by a leukopenia which steadily increases and lasts for from two to four days. Regeneration of the elements of the blood takes place following large doses as well as small. The influence of irradiation on the blood is determined by the size, intensity, and character of the dose, larger doses producing greater changes

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The therapeutic measures for the treatment of leukemia were, for the most part, symptomatic and directed against the associated anemia until relatively recent years, when it was discovered empirically that certain agents have a more or less specific effect in reducing the greatly increased number of white cells. Therefore, modern treatment is directed not only toward the secondary anemia, but toward the leukemia.

The general management of patients suf-

fering with chronic leukemia should include the best possible hygiene, outdoor life with its fresh air and sunlight, and exercise regulated to the strength of the individual patient. The diet should be adjusted to the requirements of the patient, consisting in many cases chiefly of fruits, vegetables, and milk. Physiotherapy, especially in the form of tonic ultra-violet ray, may exert a beneficial influence on the general well-being of the patient. We should not neglect medicinal measures such as iron and arsenic in their various forms. Transfusions, red bone marrow, and colloidal metals have been advocated.

Spontaneous remissions occur normally but rarely in chronic myelogenous leukemia. Minot, Buckman, and Isaacs (16) observed definite spontaneous moderate remissions in 7.7 per cent of 52 non-irradiated cases. Untreated cases are slowly progressive, and usually have a slow downfall, though the patient may remain for a long time in a poor state of health. The measures which have been directed toward the treatment of leukemia are splenectomy, benzol, roentgen ray, radium, thorium, and some of the other radio-active preparations. These remedies have been used to bring about remissions in the chronic type of the disease, but acute leukemia is apparently influenced very little, if at all, by any type of treatment.

Splenectomy was the first measure directed toward the treatment of leukemia. The first case of removal of the spleen for myelogenous leukemia was reported by Bryant (3) in 1866. The patient, who had a very large spleen, was in poor general condition and died soon after the operation. Giffin (9b) states splenectomies were performed, not infrequently, during the period from 1866 to 1900. According to him, the

¹Read before the Radiological Society of North America, at the Sixteenth Annual Meeting at Los Angeles, Dec. 1-3, 1930.

irradiation over the spleen or marrow of the long bones, a rapid fall in the number of leukocytes is noted. There is also a decrease in the size of the spleen, but not in proportion to the leukocyte count. The red blood count and the percentage of hemoglobin improve, and there is also a rapid improvement in the general condition of the patient.

Every case of myelogenous leukemia has its own peculiarities with regard to severity, rapidity of change, and response to treatment. The blood picture and the general condition of the patient should be observed before each application of X-ray or radium. The frequency of irradiation is a very important factor in the treatment of leukemia, and the leukocyte count should not be depressed below twenty or thirty thousand. Treatment given early in a recurrence is more likely to be effective than after the change has become well established, and improvement may be obtained by a relatively small amount of treatment as compared to the quantity of irradiation required after the recurrence has become well established.

The remissions may last for a few months or even years. There is always a recurrence and subsequent remissions are increasingly difficult to obtain. Following irradiation the manner in which the remissions occur and the real underlying reason are obscure. The bone marrow itself is the seat of the pathologic process, and it is a matter of conjecture how irradiation to the spleen exerts so powerful a depressing influence on the white cell elements in the remote bone marrow. As a rule the leukoblastic tissue is very susceptible to the influence of X-ray or radium, but the effect is not a direct one, because the treatment applied to the long bones themselves is usually not so effective as that given over the spleen. Irradiation of short wave lengths produced by either X-rays or radium furnishes a more penetrating ray and the effects of treatment are more

quickly seen. The less penetrating effect of long wave length X-rays requires a little longer time to produce the same result. It is true that marked symptomatic improvement and immediate reduction of the white cell count rapidly follow the application of intensive massive doses of X-rays or radium. However, there is no definite evidence at the present time to support the view that strong initial irradiation of short wave length will postpone recurrences any further, or give greater relief in the interval of freedom, than is obtained with rays of only moderate penetration and intensity. Leukemic patients develop a tolerance to irradiation, and, as time goes on, a more penetrating ray, longer course of treatment, and longer intervals between treatments are necessary.

There is as yet no optimum dose of X-rays or radium for the correct treatment of leukemia, each therapist emphasizing his individual technic almost to the exclusion of all others. We advise moderate doses of X-rays, repeated at intervals as indicated by the leukocyte count, and the general well-being of the patient. A number of radiotherapists advocate this method of irradiation. It must be remembered that intensive short wave length irradiation, whether from the gamma rays of radium or high voltage X-rays, gives relief only. One must also remember that the system builds an immunity against these intensive short wave length rays, so that after several treatments the intensive short wave length therapy fails to produce the desired remissions. Therefore we deem it safer to start with the longer wave length X-rays (*i.e.*, 80 to 100 K.V. filtered through 3 to 4 mm. of aluminum, depending upon whether treating over spleen or long bones), over the spleen, chest, or long bones, reserving the heavier forms of irradiation from radium or X-rays until the inevitable time when the lighter forms of irradiation have exhausted their usefulness. In other words, the smallest effective dose

than smaller ones. Patients treated over the spleen, chest, abdomen, and pelvis show the most pronounced reaction. The action of radium and X-rays on the blood is similar, but because the surface or area exposed to radium is generally smaller, the reaction is less pronounced. The chief effect of irradiation on the normal spleen and lymph nodes is limited to the destruction of lymphocytes, and is much more pronounced when these structures are in a state of hyperplasia from any cause. In the case of exposure of equal body surfaces to radium or X-rays, the action of the radium is more intense than that of the X-rays, and subsequently more extensive replacement of connective tissue results.

The effect on the blood-forming organs is made use of in the treatment of certain diseases of the blood, spleen, and lymph nodes. In the treatment of leukemia, the great capacity of irradiation to destroy lymphocytes and to produce leukopenia is valuable, because the leukocytosis produced by this disease can thus be greatly reduced. The treatment is largely concentrated on the spleen in the myelogenous type, but if this is not sufficient, the effect can be increased by treating the marrow of the long bones.

Strumia (30, 31), in discussing the effect of radium applications on the morphology of the blood in myelogenous leukemia, reached the following conclusion:

The mechanism of action of radium upon the leukemic foci is of generalized as well as of localized nature. That is, when radium is applied to any portion of the body, its effect is carried by the blood stream to the leukopoietic foci. Thus from a local application a generalized effect is obtained.

Our experience in 25 cases seems to indicate that the effect obtained is in proportion to the number of square centimeters of skin surface irradiated, and upon the size, intensity, and character of the dose. Large doses

produce greater changes upon the normal circulating blood as well as upon the abnormal blood.

The leukemias are characterized by a natural progression to a fatal end, in spite of all treatment. The rate of advance is subject to wide variations, some cases being much more acute than others. Minot (16) expressed the opinion that those individuals destined to have a short duration of life usually have a stormy and impressive onset of symptoms, which lead to earlier diagnosis and treatment than in the more chronic cases of myelogenous leukemia.

The average duration of life in 102 cases treated by Fricke (8) at the Howard A. Kelly Hospital was one and one-half years. Minot (16) and associates studied the records of 166 cases of chronic myelogenous leukemia, and found that the average length of time between the appearance of symptoms and diagnosis was 1.4 year, and that the average duration of life was about 2.5 years.

Irradiation is the treatment of choice, as it maintains the efficiency of the patient to a greater extent than any other known remedy. In most cases it produces remission from symptoms and reduces the high leukocyte count. Minot (16) found that 50 per cent of the patients, some of whom were bed-ridden, improved sufficiently to permit them to resume their activities. He claims increased efficiency of the patient whether therapy is administered early or late in the course of the disease. Forssell (7) and Walterhofer (34) claim that definite improvement takes place in 90 per cent of the cases of myelogenous leukemia receiving adequate irradiation. Remissions are obtained by irradiation applied over the spleen, over the marrow of the long bones, or in both places. The most rapid remissions are unquestionably obtained by treatment over the spleen, chest, abdomen, and pelvis, because the total area irradiated is greater and the total dose is more intense. Following

smooth, surface was of a pale color, mottled with indefinite darker areas. Cut surface was grayish-red, finely granular and opaque. Microsections made of several areas of spleen showed the venules of the splenic pulp

count, found an increase in the number of white cells. At the time he entered the Mayo Clinic (February 25, 1922) his blood count showed a hemoglobin of 50 per cent, red blood cells 3,080,000, and leukocyte count

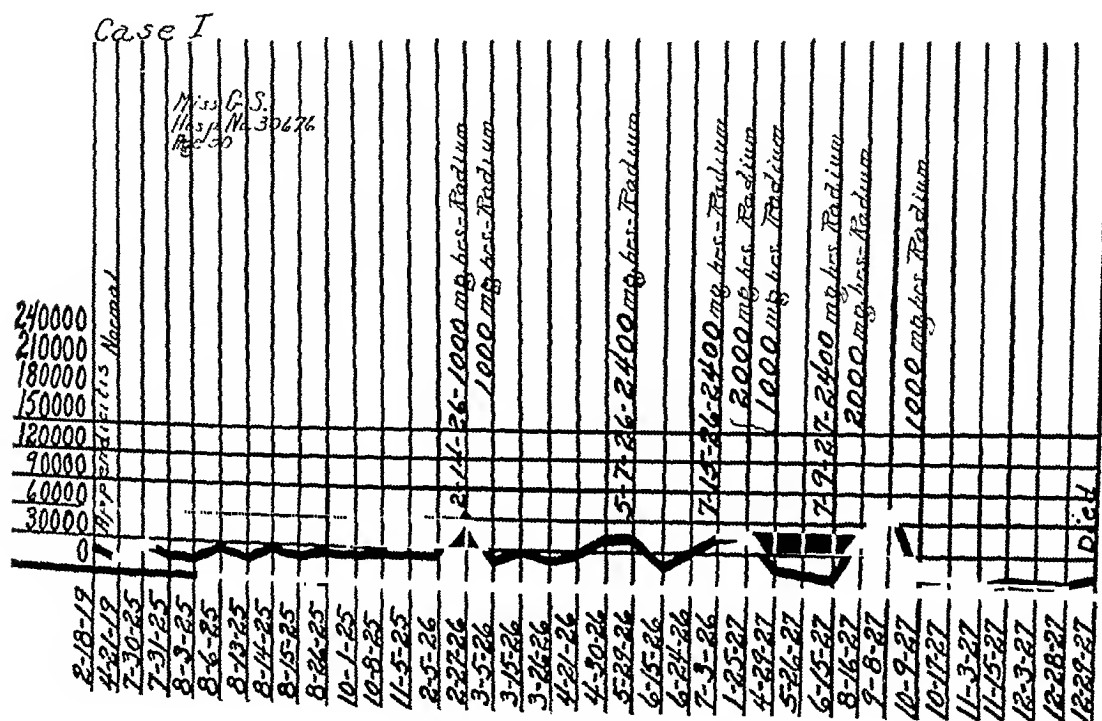


Fig. 1. Chart of Case 1.

to be filled with myelocytes and large cells of myeloblastic origin. No malpighian bodies were demonstrated. Sections showed the presence of myeloblasts, nucleated red cells, and lymphocytoid cells.

Bone marrow: The bone marrow from a small section of left femur was firm, opaque, and of a pinkish, homogeneous appearance. Microsections through tissue of bone marrow showed diffusely scattered cells of irregular size and shape, among which were noted neutrophilic myelocytes, eosinophilic and basophilic myelocytes, numerous neutrophils, and occasional red blood cells.

Case 2. A. B. C. (physician). age 40. Patient experienced some ill-feeling and malaise, and, upon taking his own blood

count, found an increase in the number of white cells. The differential count showed lymphocytes 0.5 per cent, large mononuclears 2 per cent, neutrophils 51.5 per cent, eosinophils 3.5 per cent, basophils 4 per cent, leukoblasts 1 per cent, premyelocytes 9 per cent, myelocytes (neutrophilic) 18 per cent, myelocytes (eosinophilic) 2.5 per cent, and metamyelocytes 8 per cent. The spleen was moderately enlarged.

After a series of five radium exposures, the spleen was satisfactorily reduced in size and there was subsequent improvement in the anemia. On April 14, the hemoglobin was 69 per cent and red blood cells 4,110,000; the leukocyte count down to 29,800. A splenectomy was done April 18, 1922, the spleen weighing 700 grams. On May 18,

should be used until experience indicates that the more intense shorter wave length type of irradiation is necessary.

It should be remembered that the treatment of leukemia with X-rays or radium offers more hope than any other known therapeutic agent. No matter whether long wave length X-rays with moderate intensity, or high voltage short wave length X-rays, or the gamma rays of radium with great penetrating power and intensity are used, palliation is all that can be offered patients suffering with chronic myelogenous leukemia. The technic described gives remissions from symptoms. The writer has been immensely gratified to note, on more than one occasion, that, after the disease finally becomes refractory to the longer wave length X-rays, the more penetrating short wave length rays of either roentgen or gamma rays of radium in the form of great intensity and large doses (when necessary) can be depended upon, for a while at least, to give further remission from symptoms.

There is the greatest need for illuminating knowledge on the subject of the best form of treatment of myelogenous leukemia. We are hopeful that an optimum dosage will ultimately be arrived at for the correct treatment of the disease.

CASE REPORTS

Case I. Miss G. S., graduate nurse, aged 28. She had had the usual childhood diseases, also pneumonia at the age of 10, and typhoid at 18 years of age. She had an appendectomy in 1919 at the age of 24, at which time the leukocyte count was 15,350. Three months later her blood count was taken and was found normal. In December, 1921, the patient had a cholecystectomy and a large duodenal ulcer cauterized. In July, 1925, her first elevation of the leukocyte count was noted other than the one due to her appendix. From July to October, 1925, her leukocyte count varied from

15,000 to 31,000, and there was frequently an increase in the number of myelocytes as high as 15 per cent, and many were of the basophilic type.

This case was of unusual interest because of the peculiar blood findings, together with the clinical findings, such as slightly palpable spleen, nausea, gas, vomiting, pain, and headaches, long before the presence of characteristic findings of myelogenous leukemia appeared. A definite diagnosis of leukemia was made when the blood count in February, 1926, reached above 62,000, with an associated increase in the myelocytes and basophilic myelocytes. The patient received fifteen applications of radium over the spleen from February 14, 1926, to October 15, 1927, and three treatments of low voltage X-rays over the long bones.

This case is presented because it shows the clinical symptoms and blood findings in an early case of leukemia. The diagnosis was made or suspected very early. The blood count was rather low all during the course of the disease, at no time being above 70,000. During the last sixty days there was a deficiency in the proportion of leukocytes in the blood, ranging from 1,100 to 2,000 white cells per cubic millimeter, presenting a typical aleukemic phase of leukemia. Duration of life was two years, five months, and two days.

Autopsy Findings.—In order to shorten this report the non-essentials will be dispensed with.

Diagnosis: (1) Hypostatic pneumonia (terminal); (2) Splenomyelogenous leukemia.

The lungs showed some groups of cells, myeloid in character. The capillaries and vessels of the interlobar spaces of the liver were filled with large irregular cells, apparently of myeloblastic origin.

The spleen was markedly enlarged, measuring $24 \times 12 \times 9$ cm. in diameter and weighing 1,000 grams. Capsule of spleen

4. Spontaneous remission occurs normally but in a very small percentage of cases.

5. Splenectomy does not modify the evolution of the disease and for this reason is not superior in its effect to irradiation. Irradiation brings the blood formula to or near normal for a longer or shorter period, whereas following splenectomy the blood count remains qualitatively leukemic.

6. Irradiation of the spleen has been considered the most effective therapy of chronic myeloid leukemia since Senn, in 1903, observed that roentgen irradiation effected a reduction in the enlargement of the spleen, and an improvement in the blood picture.

7. The effects of irradiation are only temporary and recurrences develop.

8. Renewed irradiations will improve the recurrences. The frequency of treatment should be controlled by leukocytic determinations, which should not show a depression below 30,000.

9. Radium or X-ray treatments cause more or less replacement by connective tissue; the spleen develops a resistance to irradiation, and finally the radiotherapy becomes entirely ineffective.

10. The smallest effective dose should be determined and used until observation shows that a heavier form of irradiation is indicated.

11. There is the greatest need for an optimum dose for the correct treatment of myelogenous leukemia.

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port is based not only upon my own examination and that of my associates, but of men in larger centers who have had greater opportunities of seeing these cases.

There was another case which we had the opportunity to observe for a period of seven years following a splenectomy. This patient has died within the past few months. Radiation therapy was able to keep his count down. I personally do not feel that the exact number of white cells is as important as the *feeling* of the patient: It is upon that that we govern our treatment in these cases.

DR. JAMES M. MARTIN (Dallas, Texas): I want to compliment the essayist. Dr. Giles is a pupil of mine and we are proud of him down in Texas. I want to mention two cases, with both of which Dr. Giles is familiar. One was a nurse and the other a soldier and they were both stricken with myelogenous leukemia overseas during the World War. They were treated along the lines that Dr. Giles has outlined. Improvement was rapid at first and they were able to go about their regular work. The soldier was a printer and worked at his trade in comparative comfort to the time of his death eighteen months after treatment was begun. While the nurse made rapid improvement, she was not allowed to do any fatiguing work; she was comfortable and able to go about as she pleased until diarrhea became a complication. She lived two years and four months from the time treatment was instituted.

While radiation therapy cannot cure this disease, it does relieve the symptoms and prolong life for varying periods of time.

DR. FRANK E. BUTLER (Portland, Oregon): I have treated several cases of myelogenous leukemia very successfully. I think of one patient with a white count of 1,250,000, who cleared up with therapy and was able to carry on his work for five years before death.

The point which I wish to emphasize is not to over-treat. I recall one case which I over-treated. The myelocytes completely disappeared and the patient started to have hemorrhage. We finally succeeded in checking it,

but nearly lost the patient as the result of too much treatment.

In all these cases the blood count should be watched carefully and the treatments given in small doses a few days apart so as to avoid over-radiation.

DR. WILLIAM H. SARGENT (Oakland, California): It may be of interest to report a case recently treated at the Highland Hospital, in Oakland. The patient was a woman about 29 years of age in whom the disease was found between the second and third months of pregnancy. The white count was 250,000, myelocytes 24 per cent. The questions which arose in this case were whether or not the X-ray treatments would injure the fetus and whether pregnancy should be interrupted. X-ray treatments were decided upon and given as follows: One-tenth of an erythema dose applied over the entire posterior chest, but directed more particularly over the spleen. The lower abdomen and back were covered to protect the pregnant uterus. In five days the leukocyte count dropped 4,000. The dose was then increased slightly and given thereafter at from five- to seven-day intervals until the count reached about 20,000. From then on, small doses at intervals of two weeks reduced the cells to 8,000 and held them there. Pregnancy went to term and a normal child was delivered. For four weeks before and eight weeks after confinement no treatments were given—a total of about three months. The white cells had again increased to 90,000, with 10 per cent myelocytes. The same small doses again reduced them to around 8,000, but from 1 to 2 per cent myelocytes persisted. In this particular case the X-ray treatments did no apparent harm to the fetus, even though started in the early months of pregnancy.

A MEMBER: I would like to ask the essayist a question: How soon after therapy and blood displacement do you expect beneficial changes in the blood?

DR. GILES (closing): As I have had no experience with the intravenous chloride treatment of these cases, I was glad that Dr.

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DISCUSSION

DR. R. S. STONE (San Francisco): We are very much indebted to Dr. Giles for bringing this subject before us again. It is constantly interesting, and although very few of us have any number of these cases to treat, they are always of great interest. Dr. Giles has passed over the question of intravenous thorium and radium treatments. If you recall, some years ago, Dr. Rollin H. Stevens, with whom I was associated at the time, read a paper before this Society on the use of radium chloride intravenously, at which time we were having some success in giving it to patients who had reached the stage shown in the last chart presented by Dr. Giles—when somewhat X-ray-resistant. At that time the use of intravenous radium chloride seemed to bring the patient back. I have had a rather sad experience with that method since I came out to California. We had a patient who became X-ray-resistant and was running a white count of 650,000, but feeling well and going about

her daily work. However, we thought that count was a little high for a patient to go around with, so we gave her 25 micrograms of radium chloride intravenously, whereupon she promptly went into the hospital and has been almost in *extremis* since. I do not know how much the radium chloride had to do with bringing on this condition which 650,000 cells in itself could bring on. I have not yet given up hope that intravenous radium will prove useful.

It is generally stated that we should govern our dosage of therapy by the number of white cells in the blood stream, and that, as I gather, is one of the controlling factors that Dr. Giles brought before us this morning. I think, however, we must realize that it is a question not only of quantity but of quality, and that one may have a patient with 3,000 white cells, practically all of them abnormal, who needs treatment worse than another patient with 30,000 cells, most of them of the adult type of leukocyte. So I think we need more study of our X-ray treatment of these conditions, basing the treatment on the type of cell present in the blood stream.

DR. H. A. SPILMAN (Ottumwa, Iowa): I have not had a large experience in myelogenous leukemia, but there is one case that has come under my attention for relief from gastro-intestinal symptoms—he was absolutely positive that he had a gastric carcinoma. When he came in the blood count was discovered to be seventy to eighty thousand, characteristically myelogenous leukemic in type. There is a question involved in this case which may arise in other cases, in that the patient has had a pyelitis for many years and has had a prostatotomy to improve the drainage, so there has been a decided difference of opinion for a considerable time as to whether or not it is a true leukemia. Slides have been sent to Dr. Minot and to numerous places, and the consensus of opinion is that it is a myelogenous leukemia. The patient has responded to moderate doses, but there has been recurrence of the gastro-intestinal symptoms. Another feature has been the absence of any palpable enlargement of the spleen. This re-

port is based not only upon my own examination and that of my associates, but of men in larger centers who have had greater opportunities of seeing these cases.

There was another case which we had the opportunity to observe for a period of seven years following a splenectomy. This patient has died within the past few months. Radiation therapy was able to keep his count down. I personally do not feel that the exact number of white cells is as important as the *feeling* of the patient: It is upon that that we govern our treatment in these cases.

DR. JAMES M. MARTIN (Dallas, Texas): I want to compliment the essayist. Dr. Giles is a pupil of mine and we are proud of him down in Texas. I want to mention two cases, with both of which Dr. Giles is familiar. One was a nurse and the other a soldier and they were both stricken with myelogenous leukemia overseas during the World War. They were treated along the lines that Dr. Giles has outlined. Improvement was rapid at first and they were able to go about their regular work. The soldier was a printer and worked at his trade in comparative comfort to the time of his death eighteen months after treatment was begun. While the nurse made rapid improvement, she was not allowed to do any fatiguing work; she was comfortable and able to go about as she pleased until diarrhea became a complication. She lived two years and four months from the time treatment was instituted.

While radiation therapy cannot cure this disease, it does relieve the symptoms and prolong life for varying periods of time.

DR. FRANK E. BUTLER (Portland, Oregon): I have treated several cases of myelogenous leukemia very successfully. I think of one patient with a white count of 1,250,000, who cleared up with therapy and was able to carry on his work for five years before death.

The point which I wish to emphasize is not to over-treat. I recall one case which I over-treated. The myelocytes completely disappeared and the patient started to have hemorrhage. We finally succeeded in checking it,

but nearly lost the patient as the result of too much treatment.

In all these cases the blood count should be watched carefully and the treatments given in small doses a few days apart so as to avoid over-radiation.

DR. WILLIAM H. SARGENT (Oakland, California): It may be of interest to report a case recently treated at the Highland Hospital, in Oakland. The patient was a woman about 29 years of age in whom the disease was found between the second and third months of pregnancy. The white count was 250,000, myelocytes 24 per cent. The questions which arose in this case were whether or not the X-ray treatments would injure the fetus and whether pregnancy should be interrupted. X-ray treatments were decided upon and given as follows: One-tenth of an erythema dose applied over the entire posterior chest, but directed more particularly over the spleen. The lower abdomen and back were covered to protect the pregnant uterus. In five days the leukocyte count dropped 4,000. The dose was then increased slightly and given thereafter at from five- to seven-day intervals until the count reached about 20,000. From then on, small doses at intervals of two weeks reduced the cells to 8,000 and held them there. Pregnancy went to term and a normal child was delivered. For four weeks before and eight weeks after confinement no treatments were given—a total of about three months. The white cells had again increased to 90,000, with 10 per cent myelocytes. The same small doses again reduced them to around 8,000, but from 1 to 2 per cent myelocytes persisted. In this particular case the X-ray treatments did no apparent harm to the fetus, even though started in the early months of pregnancy.

A MEMBER: I would like to ask the essayist a question: How soon after therapy and blood displacement do you expect beneficial changes in the blood?

DR. GILES (closing): As I have had no experience with the intravenous chloride treatment of these cases. I was glad that Dr.

Stone spoke of this type of treatment. Leukemia responds more readily to the short wave length X-rays or radium than to the longer wave length type of radiation. The response to treatment depends on the size, character, and intensity of the radiation dose.

The question of sufficient treatment is often difficult to determine, but, as Dr. Butler brought out, over-treatment may do as much harm to these patients as under-treatment. Over-treatment is to be avoided because it

contributes nothing to the temporary improvement and may make subsequent remissions more difficult to obtain.

The white blood count, the myelocytes, and the myeloblasts constitute a good index to the activity of the disease and a guide to further treatments. The smallest effective dose necessary to reduce the blood count in myelogenous leukemia is recommended, and then just enough to keep it approximately within the range at which the patient feels the best.

EPILEPSY DIET PROVOKES PELLAGRA

New light has been shed on the epilepsy problem which may lead to discovery of a cure for this baffling disease, or at least to a knowledge of its cause, as a result of a discovery by Dr. N. P. Walker, Director of the Milledgeville State Hospital, Georgia, and Dr. G. A. Wheeler, of the U. S. Public Health Service, Washington, D. C.

Dr. Walker observed that sufferers from epilepsy, when fed a high-fat diet, were benefited as far as the epilepsy was concerned, but developed pellagra, the "hard-times disease" which is believed to be due to a lack of Vitamin G in the diet.

In collaboration with Dr. Wheeler, Dr. Walker studied ten women patients suffering

from epilepsy. He found that when they were fed a diet nearly completely lacking in Vitamin G but otherwise complete in all respects, the number of epileptic seizures was greatly reduced and the nervous symptoms due to the epilepsy also improved. However, the patients developed pellagra while on this diet. When the pellagra was relieved by feeding yeast, a rich source of the anti-pellagra vitamin, the epilepsy became worse.

No conclusions can be drawn from these observations, and it is not suggested by Dr. Walker and Dr. Wheeler that pellagra be used to treat epilepsy, as malaria is used for treating paresis. However, their study points the way for further research on epilepsy which may yield final solution of the problem.—*Science Service.*

CLINICAL AND EXPERIMENTAL OBSERVATIONS RELATIVE TO THE ETIOLOGY OF CANCER¹

By MONTROSE T. BURROWS, M.D., PASADENA, CALIFORNIA

I WISH to describe in this paper some recent experiences in the treatment of carcinomas of the breast, skin, and lip in cases in which these lesions have been studied and treated as the direct result of some local, followed by some general, deterioration of the organism.

In a former paper before this Society, and elsewhere, it has been pointed out that one of the striking differences between malignant tissues and normal tissues is the deficiency of the fat-soluble growth-promoting vitamins in the former tissues. In other studies with the tissue culture it has been shown that differentiation is associated with the accumulation of certain lipid substances in the tissues. With the accumulation of these lipid substances within the cells and the intercellular substances the ability of these cells to grow in a plasma culture decreases proportionately. If means are provided for the removal of these lipid substances, growth then intervenes readily in these same differentiated cells. Careful feeding experiments were then undertaken to determine the fat-soluble vitamin content of embryos of various ages. These experiments indicate that the growth-promoting fat-soluble vitamin content of the tissues varies directly as the content of this growth-inhibiting lipid substance varies in these same tissues (1) (2).

That cancer may be the direct result of the removal of these fat-soluble vitamins from small areas of tissue in the body seemed, therefore, to be a logical conclusion from these experiments. In further proof of this idea it has been shown that certain lipid solvents such as coal tar, etc., when

applied repeatedly to an area of tissue in certain animals, will induce a malignant growth. In later experiments Ernst, Jorstad, and I were able to show that X-rays act in a similar manner. The coal tar evidently induces cancer in that it dissolves the lipid substances and removes them from the tissues. X-rays act differently. They liberate the vitamins from the tissues and cells so that they can be taken up and removed from tissues by other cells of the organism (3).

In still other experiments, I was able to show that an injury leading to an overgrowth of cells might also produce these same changes (4) (5). The cells of the body when placed in a drop of plasma do not grow at the expense of the plasma but at the expense of other cells in the culture. The plasma acts only to dissolve and remove the excess of lipid inhibitor from about the cells. The border cells of a fragment of tissue brought thus in contact with the plasma grow actively at the expense of the more central cells of the fragment. On studying more carefully the tissues most suitable for food for other cells, it has been found that for any group of cells to nourish other cells it is necessary that that group of cells shall contain an ample quantity of the fat-soluble growth-promoting vitamin. Body cells are apparently dependent upon this lipid for building the lipid of their protoplasm. As these cells are dependent for their growth upon fat and protein supplied from external sources, so they are dependent also upon properly synthesized lipoids for the building of their protoplasm. These lipoids are obtained as the fat-soluble vitamins of the food, and as they accumulate in the intercellular substances they act

¹Presented before the Sixteenth Annual Meeting of the Radiological Society of North America at Los Angeles, Dec. 3, 1930.

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to inhibit growth and induce differentiation in these cells (6).

Abnormal stimulation of a tissue or a part leads to the use of much of the excess of this vitamin for the building of new cells and removes it from the intercellular areas. Lesions are thus produced which are quite similar to those produced by X-rays and coal tar.

From the latter observations it became evident, therefore, that any repeated injury leading to growth and repair might exhaust this tissue of its normal growth-inhibiting lipoid and produce a typical precancerous area. Any break in the normal hormone balance in the organism might also excite abnormal growth in an organ or tissue and eventually lead to the same changes.

A SYSTEMIC FACTOR

In a further careful study of the action of coal tar it was noticed that, when coal tar is applied to the skin of an animal, the animal suffers not only from the local irritating effect but also from a general systemic deterioration which may be the result of a general decrease in fat-soluble vitamin content of the animal (7). It suffers a true cachexia not different from that seen in cancer. In mice, this cachexia always precedes the development of cancer. In rats, a cancer rarely ever develops. The rats, on the other hand, die sooner or later in cachexia after the beginning of the application of the tar. The same is true of the rats treated with X-rays.

We wondered then whether there might not be a systemic factor as important as the local factor in the development of cancers. About this time it was our good fortune to make an observation which not only indicated that this might be the case, but that this cachexia might be produced also by conditions quite different from those inducing the local lesion. A member of the

laboratory staff decided to place herself on a deficient dietary. She chose chopped meat and vegetables as food. This food she boiled twice, pouring the water off after each boiling. She knew that she had a very small tumor under the skin of her arm which had come after an injection of camphor in oil eleven years previously. She had forgotten, however, about this tumor. After three weeks on the above diet this tumor was as large as a walnut and she could not move her arm. A good dietary, including ample butter fat and cod liver oil, restored this tumor to its former size in one week. We removed it and found it to be a typical camphor oil tumor (8).

It was these facts which led me to believe, therefore, that spontaneous cancer might be due always to two factors, a local lesion and a general drop in the nutrition of the whole. This idea seems logical because it is most unlikely that any cell or group of cells can develop sufficient energy to overcome the energy of the cells about them in a normal organism unless these cells have suffered a preliminary period of growth and adaptation.² On the other hand, if these cells about them are injured first, so that their resistance is lowered, then this growth might take place most readily. It had thus become of interest to study cancer cases more carefully with this idea in view.

EARLY STUDIES OF CANCERS IN MAN

After beginning a study of cancer cases in California in 1928, we appreciated that such a study might be most productive of results because very few such studies had been made. Hysteria among the laity had led the physician to rush madly for some means to treat the cancer. He had expended his energies almost entirely upon finding some new means of removing or

²Transplantable tumors are well developed spontaneous cancers and their ability to continue growth in normal parts increases with each succeeding early transplant.

destroying this growth, and had forgotten all about the other ailments from which these patients might be suffering at the same time.

While all of our studies have indicated that nutritional disturbances are at the bottom of cancerous processes, there is no reason to believe that these nutritional disturbances are caused always by a lack of food. In fact, the American public as a whole is well fed, except perhaps for a certain lack in certain fat-soluble vitamins. This latter deficiency is not so striking, however, as many authors would lead us to believe.

As must be pointed out clearly here, however, the nutrition of a patient is determined not alone by his food intake but also by his ability to use this food. Various toxic conditions may prevent the proper utilization of any dietary. I have had many anemic patients come to my office for advice, telling me that they have adhered strictly to a good dietary, without results. The removal of a single dead and abscessed tooth was sufficient to cure many of these patients within a few weeks. An infected but symptomless tonsil, appendix, or gall bladder may have been the offending agent in other cases.

CANCER A SYMPTOM OF SYSTEMIC AND LOCAL DETERIORATION

With these particular ideas in view, I reported the first 43 cases studied (9). I reported these cases because the results were striking and it had been stated that cancer develops often in otherwise normal individuals. In each of the 43 cases I found the cancer developing not only on a previously existing lesion but always after the patient had suffered first from a definite disturbance, often quite distant, which caused a drop in his general nutrition. In only eight of these cases could I account for the drop

in the general nutrition by deliberate or forced starvation: the remainder were well fed. Their cachexia had developed from other causes. Dead and abscessed teeth could have accounted for the cachexia in 22 of these cases; poor dietary in the treatment of diabetes accounted for the cachexia in two other cases. In eight cases there was a recurrence of tertiary syphilis, together with dead and abscessed teeth. Starvation, with gastric disturbances lasting over two years, was present in two cases of gastric cancer. Chronic prostatitis, with arthritis and chronic tonsilitis and a kidney lesion, was present in two cases. The local lesions in these cases were found in the breast, stomach, skin, lip, tongue, cervix, uterus, and intestines. The cause of these lesions could be traced to chronic infections, hormone imbalances, mechanical injuries, the use of alcohol, tobacco, etc.

TUMORS OF THE BREAST

In this same former publication (*loc. cit.*) I had pointed out that the original breast lesion in eight of the twelve breast cancers developed along with an existing endocervicitis. The other four cases traced their cancers to accidents of nursing. A more careful study of the history of the last four cases has now revealed the fact that they were also suffering from an endocervicitis at the time of the development of the caked breasts. In none of these cases did cancer develop, however, until they had first suffered from abscessed teeth and the general cachexia resulting from them.

Fifty-four more tumors of the breast have now been added to this series of breast tumors. Among these there were 28 cases of carcinoma of the breast, representing only cases which I was able to see in the office or in the clinic and upon which I was able to make a most careful physical examination and from which I was able to obtain

a complete history. The remaining 26 patients had benign lesions in their breasts.

Out of the 26 cases of benign breast tumors now carefully studied, there were two cases with fibrous breasts, the lesion being bilateral in each instance. They occurred in unmarried women of the type who do not marry. These patients were also suffering from a degeneration of the uterus, with small fibroids. The breast in one of these cases was removed, and was found to be composed of a solid mass of hyaline connective tissue in which only a few of the larger ducts had persisted. Near the nipple of this breast was a large area of calcification (quite typical bone formation), the whole resembling very much the calcified thyroids seen in certain types of goiter. The uterus in the other case was removed on account of a bleeding submucous fibroid and a vaginitis and cervicitis. The operation was performed in February, 1930. The breasts had softened very decidedly by the following September, but they have not healed completely.

There were two cases of multiple lumpy breasts in unmarried women 32 and 35 years old, respectively, both of which had shown marked symptoms of undeveloped thyroids, dysmenorrhea, and some vaginal discharge. One of these patients developed a small goiter three years ago and is now showing more definite symptoms of hypothyroidism.

There was a case of diffuse adenomatous degeneration of both breasts and one case of intracanalicular adenofibroma, with one small cystic adenofibroma. In this latter case both lesions existed in one breast. The woman is a large, moderately fat, thyroid type, with some evidence of a previously existing specific endocervicitis. The former case of diffuse adenomatous change was in the breasts of an unmarried woman, aged 44, suffering from a very definite endocervicitis, with excessive menstruation at irregular intervals. Whether or not a

specific infection existed in the uterus of this patient could not be determined. Before the breasts were removed she had suffered little from the uterine condition, but had run a fever for three years which she had finally associated with the breasts. The uterine lesion then became quite active a year after the removal of both breasts.

The remaining benign lesions, 20 in number, occurred in married women. Six of them had never had children; eight had had one child each; two had had one child each, and later one or more miscarriages; four had had two children each, with or without later miscarriages. Careful physical examination of these women showed practically all of them to be healthy persons except for chronic endocervicitis. In each instance the patient gave a history of the uterine lesion having existed for several months, and often for several years, before the appearance of the tumor in the breast. Six of these cases have now been operated on, each one of them showing the same type of lesion, classed as chronic cystic mastitis.

This latter group of women, quite different from the other cases mentioned above, gave normal menstrual histories. Their trouble had come on after the development of an endocervicitis and in most instances it was possible to prove definitely that the uterine and cervical lesions were of specific origin.

CANCER OF THE BREAST

Most of the breast cancers developed in women who had carried tumors in their breasts for several months or years before the onset of their serious trouble. Nine of those women were between the ages of 35 and 40; six were between the ages of 40 and 50; eight were between 50 and 60; five were between 63 and 70. All gave very definite histories of chronic endocervicitis and in most instances this was evidently of specific origin. In four of the cases only did we

believe that endocervicitis might have developed otherwise, these having suffered for many years from chronic appendicitis and other intestinal lesions, which may have accounted for the uterine infection. Besides these particular lesions, all these patients, except one, were suffering from dead and abscessed teeth; this latter case had degenerate tonsils and chronic cholecystitis. There were degenerate tonsils in six of the other cases, and in two, there were dead and abscessed teeth and an active chronic appendicitis and cholecystitis. In a third case there was one dead tooth, an active subacute and chronic appendix, and a gall bladder with stones.

While the uterine lesion seemed to be important in the development of the precancerous lesion of the breast, there was no evidence to show that it played any important rôle in the development of the cachexia and the cancer itself. In more than half of the cancer cases the breast lesion had been carried for from ten to thirty-nine years. It was only with the development of the deteriorating lesion, a lesion capable of causing marked cachexia, that the malignancy developed.

EFFECT OF THE REMOVAL OF THE CERVIX AND UTERUS OR UTERUS ALONE ON THE PROGRESS OF BENIGN TUMORS OF THE BREAST

The one case with chronic fibrous breasts from which the uterus, tubes, and cervix were removed has been described above. A distinct softening of the breast is now noted after eight months. This patient had a persisting vaginitis, which is also improving at this time.

Another patient, coming to the clinic in January, 1930, was suffering from multiple ill-defined lumps in both breasts and an endocervicitis. She had had six children, all of whom are living and well, the oldest, 26, the youngest, 12. There was also



Fig 1-A. Photograph showing a cancer in the left breast of a woman suffering from abscessed teeth and who had suffered for many years from chronic endocervicitis.

a small fibroid in the wall of the uterus and one tooth with a root canal filling, but no abscesses. The uterus and dead tooth were removed. The breasts have now healed after eight months, only one very indefinite area of induration persisting.

Another patient tells me that she had carried lumps in her breasts for years, and that she had suffered also during that time from severe pelvic distress. She says that operative relief for the pelvic lesion led to the disappearance of the lumps in the breasts after four months.

A woman, aged 32, with an active endocervicitis and a definite lump in her right breast, became well after ten days of medical treatment for the endocervicitis. This lump recurred, to disappear again with more medical treatment of the uterus.

RESULTS OF REMOVING TEETH AND OTHER LESIONS ON THE TREATMENT OF CANCERS OF THE BREAST

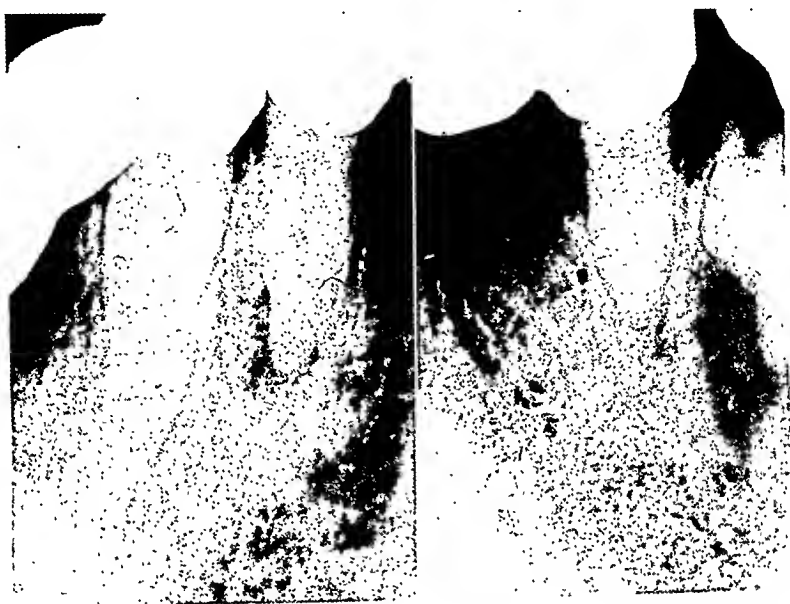
All patients with cancer of the breast coming for treatment have been studied

carefully for degenerate lesions, and, when possible, these lesions have been treated carefully before the cancer was considered. Our results have been exceedingly good.

Two patients with carcinoma had had their diseased teeth removed at the time of

very well. Her blood count is normal. The cancer itself is apparently having no particular effect on her general nutrition.

Two cases of early carcinoma of the breast developing in typical areas of chronic cystic mastitis were examined in May and



Figs. 1-B and 1-C. Negative prints of X-ray films of a few of the abscessed teeth in the case shown in Figure 1-A.

the development of the cancer. One was a typical case of Paget's disease in a woman of 59, who had had eczema about the nipple for two years. I removed the breast and found a cancer of the duct, but no extension to the lymph glands. The other patient had developed a cancer in her left breast thirteen years previously. Her teeth had all degenerated just previous to the development of the cancer. She had them removed just after the cancer developed. She had also had a partial treatment of the breast with X-rays, stopping because of roentgen sickness. During the thirteen years the cancer has slowly distorted the breast, but there had been no extension to the axilla, the lungs, or other parts. She has refused to have the breast removed because she feels

September, 1928, respectively. The first patient, aged 44, had noticed a lump in her right breast one year previously. During the following winter she began to suffer from fatigue. Recently the lump has grown and pain and swelling have developed in her knees. She had two dead teeth with apical abscesses, an emphysema of the lungs with chronic bronchitis, and arthritis of both knees. She suffered severely from uterine disturbances when her only child, now aged 12, was born. However, the uterine lesion healed apparently a few years ago. The two dead teeth were extracted and later the breast, together with the glands beneath the pectoralis major, were removed, the muscles being left intact. This woman gained 20 pounds during the next year and her anemia



Fig 2-A Multiple carcinomas of the lower lip.

disappeared, but the arthritis in her knees and the emphysema have remained about the same. There has been no evidence of any recurrence of the cancer, three years and three months after treatment.

The other woman, aged 69, had noted a decline two years previously while making a trip around the world. In India she had several teeth removed. In May, 1928, she had a bridge constructed on two dead teeth which showed no abscesses. Immediately after this she became anemic and her right breast began to cause her trouble. When she came for examination in September, 1928, she had an area of well defined chronic mastitis in the right breast. She had suffered caking of this breast while nursing her first baby, thirty-nine years previously. Another child had been born four years after the first. She had suffered from vaginal discharge from the time of the birth of her first child until her menopause. There had been no other pregnancies.

This patient refused to have her teeth re-



Fig. 2-B. Same case as shown in Figure 2-A. Dotted line indicates the line of incision for the removal of two of the carcinomas.

moved and did not return again until January, 1929, at which time she had more definite signs of cancer of the breast. A radical operation was performed at once and an area of chronic cystic mastitis with cancerous degeneration was found in the breast, but no glands were involved. In February, 1929, she developed arthritis in five joints. Her teeth were given X-ray examination at

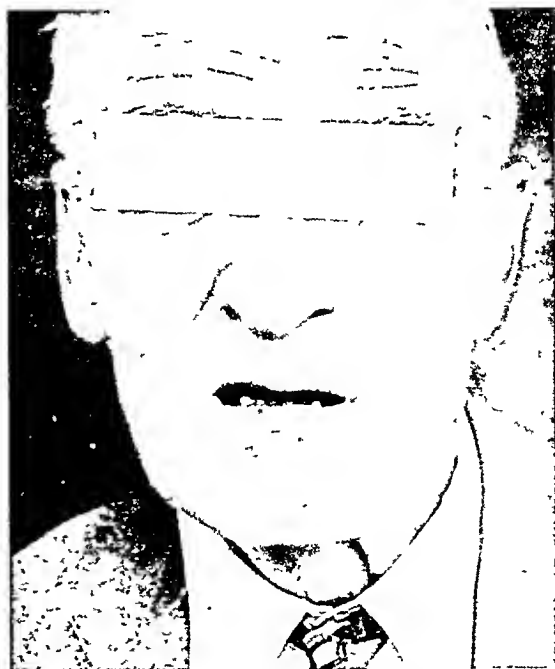


Fig 2-C Photograph of case shown in Figures 2-A and 2-B, taken four months later. The other carcinomas disappeared spontaneously after removal of the abscessed teeth



Fig. 3. Photograph of rodent ulcer on the lower right eyelid. This ulcer disappeared spontaneously in three weeks after the removal of one dead and abscessed tooth.

that time. All of them showed signs of degeneration. There were many deep pyorrheal pockets, and there were apical abscesses on the two teeth supporting the bridge. These latter two were removed, but she refused treatment of the other teeth. Her rheumatism became better but her anemia persisted. She returned again in January, 1930, with twelve recurrent nodules in the skin of the breast. This area of skin was removed and radon seeds were planted in the tissue between the ribs; however, four more nodules appeared within the next two weeks in other parts of the outlying skin. These were removed and the remaining teeth were extracted. Later, the denuded areas were covered with Thiersch grafts, the wounds healing well. Her letter, dated September 1, 1931, states that her anemia has disappeared and that she has not felt so well in years.

The results have been excellent in all the

other cases in which the degenerate lesions have been treated carefully. Two cases with dead and abscessed teeth, together with subacute appendicitis and gall-bladder disease, have run a rapid course downwards in spite of all attempts to treat the breast lesion. It was not possible to do abdominal operations in these cases.

König had looked upon chronic cystic mastitis as an inflammatory lesion. This view prevailed until the earlier writings of Schimmelbusch, who taught that it was not an inflammation but a tumor. Since that time more and more authors have taken this latter view. In 1919, Pribram (10) pointed out a possible relation of this lesion to abnormalities in the secretions from the sex glands. Later, Küchens (11), in a careful histologic study of benign lesions of the breast, took a similar view, and more recently Taylor (12), in a review of 271 cases of breast tumors from the General Memorial Hospital, has also come to the same conclusion.

While many authors do not believe that all breast cancers arise in pre-existing breast lesions, in a study of over 180 cases in St. Louis, I (13) was able to find evidence of a previous chronic mastitis in every case. Besides these cases of carcinoma, many benign lesions were also studied. It was in this investigation that I was impressed by the similarity between these breast lesions and goiters, as well as the lesions produced by coal tar and X-rays (14). It has already been shown that cancers of the thyroid arise probably always in pre-existing adenomas. By experiments we were able to show that hyperstimulation may act to remove the fat-soluble vitamins from a tissue as does coal tar.

A careful study of benign and malignant lesions of the breast has shown that uterine lesions exist in every case. This uterine lesion is not, however, responsible for the cancerous process, apparently leading only

to induction of the formation of benign lesions. Cancer has developed in these cases only when they have suffered from cachexia related to other causes, and it is interesting that teeth have been apparently



Fig 4-A. Basal-cell carcinoma which developed at the site of a boil on the right side of the neck.

the most frequent cause of this later deterioration (Figs. 1-A, 1-B, 1-C).

STUDIES OF CANCERS OF THE SKIN OF THE FACE AND THE NECK AND THE LOWER LIP

This relation of abscesses of the teeth to the development of cancer is seen also in the study of cancers of the skin and lip. Of the 102 cases of cancers of the skin of the face, body, neck, and lips, abscessed teeth were present in every case. Chronic polypoid changes in the antrum were also present in two cases and chronic degenerate tonsils were present also in the remaining six cases. In all of those instances in which we have removed the offending lesions in the teeth, tonsils, or elsewhere, a simple surgical removal of the cancer has led to quick healing, often without visible scars. In other cases in which the patients have refused to have the teeth, tonsils, or other lesion removed, either hypertrophic scars or recurrences have been the result of these simple surgical procedures.

Radium seems to act differently in this regard. When we have not been allowed to have the teeth removed and have used radium properly for the removal of the cancer, there has been no recurrence at the site



Fig. 4-B. Photograph of the same patient shown in Figure 4-A, taken four weeks later. The ulcer disappeared spontaneously, leaving only a small soft tumor to mark its site.

of the lesion, but in most of these cases cancers have appeared in other parts of the skin within a few weeks or months.

In most of these cases of cancer of the skin, senile keratoses have preceded the development of the cancers. Multiple boils have been the precursors in other cases, cancer developing finally in one of the boils. While most of these cancers have been basal-cell in type, a few typical prickle-cell cancers have been seen and they have responded as readily to this form of treatment as the rodent ulcers.

Not only the cancers are easily cured after removal of the degenerate teeth or tonsils, but the keratoses also have disappeared often. Removal of teeth, together with the administration of a small amount of cod liver oil, has caused the complete dis-

appearance of keratoses in a number of cases.

REMOVAL OF TEETH OR TONSILS WITHOUT TREATMENT OF THE CANCERS

Having obtained these interesting results we tried, then, to see what the effect of the

A man, aged 59, with recurrent boils on his neck, an infected and degenerate wisdom tooth, and other teeth with deep pyorrheal pockets, came for examination in September, a cancer having developed in one of the boils (Fig. 4). The teeth were removed. The ulcer on neck has healed; only a small soft superficial tumor in the skin marks



Fig. 5-A. Photograph showing a rodent ulcer on the lower lip of a man 83 years old, with degenerate tonsils and bilateral peritonsillar abscesses. A large shallow ulcer on his upper lip does not show.



Fig. 5-B. Photograph of the same man shown in Figure 5-A, four months later and after the tonsils and the ulcer on the lower lip had been removed. The ulcer on the upper lip disappeared spontaneously.

removal of the teeth or the tonsils might have on some of these cancers. A man with four superficial prickle-cell cancers of the lower lip and three remaining dead and abscessed teeth was treated by removing one of the cancers and the three teeth. The other cancers have disappeared without treatment (Figs. 2-A, 2-B, 2-C).

One man, aged 83, with a small early rodent ulcer on the lower eyelid (Fig. 3) and three remaining teeth, was treated by removing one abscessed tooth. Two of the three teeth were worn, but alive; the other was abscessed. In three weeks the eyelid had healed.

the site of the cancer after four weeks (Figs. 4-A, 4-B).

In another case with an associated sinusitis, the growth of the rodent ulcer ceased with the removal of the teeth but the ulcer had not healed after two years. It was removed later, with a good result. Several root fragments have been found recently in the jaw of this woman.

In another case, a man of 82 years, there were ulcers on both the upper and lower lips (Fig. 5-A). Degenerate tonsils, with discharging peritonsillar abscesses, were also present. The tonsils and the lesion on the

lower lip were removed. The lesion on the lower lip was found to be a degenerating rodent ulcer. The tonsils were found to be composed largely of dead hyaline material. The scar on the lower lip is scarcely visible, and the upper lip ulcer healed completely in six weeks' time without treatment (Fig. 5-B).

SUMMARY AND DISCUSSION

From the study of benign tumors and cancers of the breast we have come to believe that these lesions are secondary always to degeneration of the sex glands. These primary lesions in the sex glands may be congenital or acquired. In women with abnormal development of their sex glands the breasts may degenerate completely: a fibrous breast, later undergoing hyaline degeneration and calcification may be the result. Taylor (*loc. cit.*), in his studies, notes this relation of fibrous breasts to degenerative changes in the sex glands and secondary sexual characters. In apparently normal women, acquired disease of the sex organs may bring about changes in the breasts. The change in the breasts in these cases is generally a chronic cystic mastitis. Gonorrhea was probably at the root of the trouble in the uterus in most of our cases with apparently previously normal sex glands.

The histology of the precancerous breast lesions is not different from that seen in the thyroid gland, classed under the heading of goiters. These lesions are probably the result of hormonal imbalances. The breasts of women suffer from stimulation and regression during each menstrual cycle. The picture which one sees in these breasts is, according to my experiments, what one might expect from over-stimulation or abnormal stimulation in any tissue of the body. Most of these changes can be reproduced readily by coal tar or X-rays.

The changes in the breasts induced by changes in the sex glands are not sufficient,

however, in themselves, to induce a cancerous degeneration. Such breast lesions may exist and progress for years without any material harm to the individual. Cancer will develop in these lesions only when the normal cells of the body without have suffered from a sufficient lowering of their resistance to allow the breast cells to grow.

It has been interesting to note that diseased teeth can cause such a lowering of the resistance of the body to the precancerous area. While it is possible that other organs undergoing the proper type of degeneration can produce similar cachexia or reduction in the resistance of the body cells to the precancerous lesions, the teeth apparently are most often at fault in the cases of cancers of the skin and breasts. Similar cachexias may also be produced by coal tar, other lipid solvents, deficient food, etc. Since we have paid particular attention to the proper treatment of such offending tissues we have had most excellent results in the treatment of breast cancers, cancers of the lower lip, even when the neck is involved, and cancers of the skin (3).

CONCLUSIONS

1. Tumors of the breast have been associated in each instance with uterine lesions.

2. In normal women the most common benign tumor is chronic cystic mastitis. In a large percentage of these cases gonorrhea may have been the immediate offending agent to the sex glands.

3. The lesions produced in the breast in association with the uterine lesions have always been precancerous in nature. Cancer develops in these lesions of the breast only after the organism has suffered from a specific cachexia from other causes.

4. Dead and abscessed teeth have been most frequently associated with these deteriorating states (cachexias) necessary for

the development of the cancers of the breasts.

5. Dead and abscessed teeth have been frequently associated with cancers of the lips and skin and evidence is given to show that they may be the immediate exciting cause of cancers of these tissues.

6. Whether other tissues showing similar degenerative changes may also produce the same effects as the dead teeth has not been determined.

7. Removal of the teeth alone has led to the spontaneous disappearance of cancers of the lips and skin in a few instances.

8. In several cases, senile keratoses have disappeared completely after the removal of abscessed teeth and the use of a good dietary.

Author's Note: Since this work was presented a most careful study of over 100 cases of cancer in organs and tissues other than the skin has shown no relation between these cancers and diseased teeth. Diseased teeth are frequently present in cases of cancer of the tongue (an endodermal structure). Removal of the teeth has had no effect on the progress of the cancers of this organ or cancer in various other internal organs. The teeth (true ectodermal structures) seem to be related only to the development of cancers of the skin and skin appendages (breasts).

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DISCUSSION

DR. E. C. ERNST (St. Louis): We all realize that cancer is, after all, a problem or complication of diseases rather than a single entity. We must be cautious, therefore, not to lean solely in one direction or to consider one phase only of the problem of cancer. This is especially true when the question of treatment, either by X-ray, radium, surgery, or medical methods, is to be given consideration. We must view the problem from a broad, practical, general viewpoint, and above everything else be physician first and last. This is certainly true from the treatment standpoint in early and late cancer. The general physical condition of the patient is important to the extent that the local condition may be influenced thereby, but we must not rely too much on such indirect influences, lest the cancerous lesion develop beyond the reach of local methods of eradication.

I was interested recently to see the trend of studies in this direction throughout various parts of the world, particularly in the work of Dr. Handley. He emphasized the suggestive relationship of tuberculosis to cancer; but he emphasized tuberculosis not as a specific lesion but tuberculosis as a disease, particularly chronic granuloma—the scar, as you know, of a tubercular lesion. Frequently such lesions occur in infancy, but Dr. Handley emphasizes the point that during adult life something happens in the metabolism of the individual and this tubercular lesion springs into carcinoma. On the other hand, of course,

we know that carcinoma is not so infrequent in lupus, but lupus is a tuberculosis of the skin. From all angles, we have to go forward with caution in treating only the general condition of the patient or the infection, without giving due consideration to the necessary other local treatment. We all know that the cancer cell is more or less a living parasite, and we have observed, I am sure, that cancer is intimately associated with chronic infections and also particularly with lymphatic obstructions. Clinical research in this direction is worth while. We must appreciate that chronic inflammatory lesions do play a part; also, the question of lymphatic obstruction is a factor. Lymphatic block, or lymphangitis, as we know, has a relationship to definite diseases—tuberculosis, syphilis, pyogenic infections, and many of the agents which we formerly considered to be the irritants of cancer.

I feel, however, that we must be very cautious not to give too much consideration to any one phase of treatment of cancer. We must continue to be physicians first of all, and continue to give due consideration to the general condition of the patient, but always keep in mind the cure of the cancerous lesion promptly and effectively by the most direct and safe route. Future cancer treatments should continue along rather broad lines, but we must frequently stop, look, and listen.

DR. J. M. MARTIN (Dallas, Texas): The Doctor's paper is extremely radical, to my way of thinking. I am in accord with the practice of dealing thoroughly with every part of the human system, once a cancer has developed. If the teeth are bad, they should be treated or removed. It has been my experience that, once a cancer has developed, anything you may do to effect a cure must have for its object complete destruction of all tissue involved.

DR. GRACE L. HOMMAN (Los Angeles, Calif.): When I was working with Dr. Stacy at the Mayo Clinic, I was much impressed with the oral sepsis of these cancer cases; so much so that I often wondered if there was not some relationship between the disease and oral sepsis. However, when we stop to consider, nearly all these patients are

at an age when oral sepsis is common, because few persons have mouths in good condition after the age of fifty. So I believe, as Dr. Martin has said, that these patients should be put in the very best of condition when they are suffering with such a serious disease as cancer. I have seen in one patient an epithelioma of the face, a cancer of the breast, and a definite epithelioma of the vulva—the patient died of the latter. This case was certainly not one of metastasis, so one wonders as to the etiology when one finds three definite malignancies in one patient.

So far as the endocrine glands are concerned, I find very many of these patients are obese, and recently I found that one of my patients weighing two hundred and forty pounds, with a carcinoma of the fundus, had a basal metabolism of minus 22. I believe that if more work is done along this line, we may find that the endocrines play a very important part in the development of cancer.

DR. BURROWS (closing): I did not use radium or X-rays in most of these cases. To rule out any unknown effect of radium or X-rays, I removed as many of these cancers as possible by surgical methods. I developed a punch method to remove cancers from the face, so that visible scars would not remain to mark the site of the operations; on the body, the ordinary surgical procedures were used. The only patients receiving radium and X-rays were those who either refused to have their focal lesions treated or who had lesions which could not be treated. I have found that a large dose of radium generally prevents a recurrence of the cancer at the site of its removal, where the knife fails. In many of the cases I have used radon seeds. The superficial skin cancers are treated better by applying the radium to the outside.

In those patients whose focal lesions were not treated, no matter what the method used for removing cancers, they have recurred sooner or later either at the previous site or elsewhere.

I feel quite certain that few physicians are paying any attention to lesions other than the cancer in most of their cancer cases. I have

examined many cases of recurrent cancers of the skin and breast and have found practically all of them to be suffering from focal lesions of long standing, the most common being abscessed teeth. Cancers in other organs are rarely associated with this type of focal infection. When such abscessed teeth are present I have often had great difficulty in persuading the patient to have them treated. He and his dentist wish to save the teeth. Again, I have found that abscessed roots are often left after the extraction of the teeth; such roots have been found in about 10 per cent of the cases.

For this reason I have X-ray films made of the gums after extractions, as well as the gums of all patients whose teeth have been extracted at an earlier time.

It should be mentioned here that I have found no evidence to show that removal of the teeth has any effect upon cancers other than those of the skin or skin appendages (breasts, lips, etc.). Removal of the teeth in cancers of the tongue or other internal organs has had no effect. Diseased teeth have been related only to cancers of ectodermal origin in the series of cases I have studied to date.

WHITE HOT PLATINUM IS NEW LIGHT STANDARD

Molten platinum, precious metal, shining with heat, gives the world its best standard of light with which to compare the brightness of lamps or stars. At the Bureau of Standards, Washington, D. C., four physicists have produced this new light standard. Using an idea suggested by Dr. G. K. Burgess, Director of the Bureau of Standards, and his associate, the late Dr. C. W. Waidner, the platinum light standard was tested experimentally by Dr. H. T. Wensel, William F. Roeser, L. E. Barbrow, and F. R. Caldwell of the Bureau's staff. A flame of standard type, burning fuel at a

known rate, has been used in the past as a standard, but its brilliance varies with changes in atmospheric conditions.

Platinum, pure to one part in 30,000, is fused electrically in crucibles of thorium oxide.

Comparisons with its light are made when the platinum is melting or freezing. Its temperature then is about 3,200° Fahrenheit. Light produced under these circumstances is remarkably constant. Reproducibility is of first importance for a standard, and the values of the platinum standard are repeatable to a tenth of 1 per cent. The precise value of the new light standard is 58.84 international foot candles per square centimeter.—*Science Service*.

FIRST ROENTGEN EVIDENCES

By OTTO GLASSER, PH.D., Cleveland Clinic, CLEVELAND, OHIO

IN an excellent treatise, Dr. Sanford Withers, of Denver, recently described in detail in this Journal "The Story of the First Roentgen Evidence."

The first days after the discovery of the new science of roentgenology comprise a chapter of romantic interest. The introduction of X-ray plates at the court trial in Denver, described by Dr. Withers, has also been mentioned recently from information gathered from the "Electrical Engineer," New York (Dec. 23, 1896, XXII, 655) and "Electrical World" (December 19, 1896, XXVIII, 759), in my book just published by Springer, Berlin, on "W. C. Roentgen and the History of the Roentgen Rays," together with similar incidents which antedated the Denver trial.

A case which was described in detail on March 20, 1896, in the "British Journal of Photography" (XLIII, 179) and in June in the "British Medical Journal" was commented upon in American journals as early as April, 1896 ("Literary Digest," April 11, 1896, XII, 707, and "Electrical Engineer," New York, June 10, 1896, XXI, 622). The "Literary Digest" wrote, for instance, under the title: "The New Photography in Court":

"An interesting and novel case, in which the 'X-rays' practically decided the point, was tried by Mr. Justice Hawkins and a special jury at Nottingham the other day, says 'The Hospital,' London. Miss Ffolliott, a burlesque and comedy actress, while carrying out an engagement at a Nottingham theater early in September last, was the subject of an accident. After the first act, having to go and change her dress, she fell on the staircase leading to the dressing-room and injured her foot. Miss Ffolliott remained in bed for nearly a month, and at the end of that time was still unable to re-

sume her vocation. Then, by the advice of Dr. Frankish, she was sent to University College Hospital, where both her feet were photographed by the 'X-rays.' The negatives taken were shown in court, and the difference between the two was convincingly demonstrated to the judge and jury. There was a definite displacement of the cuboid bone of the left foot, which showed at once both the nature and the measure of the injury. No further argument on the point was needed on either side, and the only defense, therefore, was a charge of contributory carelessness against Miss Ffolliott. Those medical men who are accustomed to dealing with 'accident claims'—and such claims are now very numerous—will perceive how great a service the new photography may render to truth and right in difficult and doubtful cases. If the whole osseous system, including the spine, can be portrayed distinctly on the negative, much shameful perjury on the part of a certain class of claimants, and many discreditable contradictions among medical experts, will be avoided. The case is a distinct triumph for science, and shows how plain fact is now furnished with a novel and successful means of vindicating itself with unerring certainty against opponents of every class."

The presentation of the new "wonder pictures" before a solemn court had, of course, various effects. Not everybody was to be convinced immediately of the great value of such pictures for court procedures, and "some amusing remarks were made," said the "Journal of Photography": "On the defendant's counsel telling one of the witnesses that he ought to have scientific evidence as to the value of the rays, Mr. Justice Hawkins remarked, 'You might send a man to the lunatic asylum, you know, by photographing his head.' One of the barristers.

looking at the photographs, asked, 'Is this the Trilby?' etc. Evidently the 'New Photography' was treated with a certain degree of levity on its first appearance as a witness, by gentlemen of the long robe."

Another English case, in which X-ray plates were used as evidence, was described on July 17, 1896, in the "British Journal of Photography" (XLIII, 461), under the title "A County Court Judge and the Roentgen Rays."

"At the Liverpool County Court on Monday, during the hearing of an action under the Employers' Liability Act, in which a dock laborer claimed £150 damages for personal injuries, the plaintiff's counsel produced two photographs of the injured arm, taken by means of the roentgen rays. He proposed to use these photographs as evidence. The defendant's counsel objected, stating that he had no reason to believe that Dr. Buchanan, of the University College, by whom the photographs had been taken, was competent to produce reliable radiographs by the new process. Judge Shand replied that, from all he had read concerning the process, he believed that he himself should be able to take photographs by this method, providing he had the necessary apparatus. Dr. Buchanan agreed, stating that the process was perfectly simple, and could be carried out by anyone. Judge Shand felt compelled to admit the authenticity of the photographs, but stated that the question as to their value must be discussed by the defendant's counsel and the jury. When the photographs were produced, they showed clearly the injury which had been done to the bone of the plaintiff's arm and the jury awarded the plaintiff £60 damages."

The New York physician, William J. Morton, who was an enthusiastic X-ray pioneer, repeatedly called attention to the importance of X-ray pictures for expert testimony in his book, "The X-ray," which was published by the American Technical Book Co. on September 1, 1896. He states: "A

very important application of the X-ray will be in connection with expert testimony in the court. Court records contain numerous cases in which the X-ray would have been of great service. Already it has been used for this purpose . . . Figure 90 shows a picture of the knees of a person which is likely to find its way into court. The patient was thrown down with violence in a trolley-car accident more than a year ago, and has suffered more or less ever since. An exposure was first made of the injured knee only and afforded no positive evidence of the seat or degree of the injury. By resorting to the comparative method, a picture of both knees was obtained (Fig. 90) which showed that the upper portion of the large bone of the leg below the knee was nearly three-quarters of an inch wider in the injured knee than in the normal one. This was doubtless due to fracture and subsequent growth of bone. Such a picture is very convincing and would be sure to have great weight with a jury."

"*Note:* The original X-ray negative of Figure 90 is now a court record and it is impossible to obtain possession of the same to make a half-tone reproduction until the case is settled. The picture will be reproduced in future editions of this work as soon as the original negative can be obtained."

At about the same time the "Journal of the American Medical Association" (July 18, 1896, XXVII, 168) reported the use of X-ray plates in a trial in the French city of Nancy, as follows: "We note that at the trial of an action for damages at Nancy, in France, the surgeon who had charge of the injured plaintiff was accused of having caused the damage by mistaking a dislocation for a fracture. The accusation was sustained by producing in court a Roentgen photograph which showed clearly the bones in the dislocated position without a fracture." The physician lost the suit.

An interesting use of X-ray pictures in a case of attempted murder was also described in the English "Journal of Photography."

toward the end of the year 1896 ("British Journal of Photography," Oct 23, 1896, XLIII, 683).

"Henry Goodwin was again brought up last week at the Salford Police Court, and charged before Mr. R. Hankinson and Mr. Alderman Jenkins with burglary and attempting to murder Mr. Israel Rosenblum, merchant, Northumberland Street, Higher Broughton. Prisoner was remanded for another week on the application of Chief Detective Inspector Lyogue, who said there was now a likelihood of Mr. Rosenblum's recovery, but he would not be in a fit state to attend court for two or three weeks. In the course of an interview, Dr. Walmsley, the medical attendant of Mr. Rosenblum, stated that his patient had been radiographed by Mr. Chadwick, of St. Mary's Street, and, as the result of the process, the bullet was discovered in the chest. An operation with a view to its extraction will be made in the course of a few days."

The alacrity with which the medical and the judicial professions quickly took up the new discovery of Roentgen and made use of it as evidence in court trials is remarkable. It is little to be wondered at, then, that persons less concerned with the real truth

looked into this use of the X-ray for more or less fraudulent purposes. On August 8, 1896, the "London Standard" carried the following advertisement: "The New Photography.—Owing to the success Mr. Henry Slater has personally achieved with the New Photography, he is prepared to introduce same in divorce matters free of charge. Offices No. 1. Basinghall Street, City."

Just how the roentgen rays could be used for the purpose of clearing up divorce matters was not explained, but a theory about the matter was produced by the editor of the "Electrical Engineer," New York (XXII. 253), who wrote on September 9, 1896:

"Mr. Slater, as a detective, is evidently up to date. We presume he uses the X-ray to discover the skeleton which every closet is said to contain. Ability to do the detective act without squinting through a keyhole is regarded, evidently, as one of the recommendations of the rays, which themselves prefer darkness rather than light."

It is probable that the foregoing list of first roentgen evidences could be increased. These evidences form an important part of the general romantic and enthusiastic reception of the discovery made by Wilhelm Conrad Roentgen.

ULTRA-VIOLET IRRADIATION IN THE TREATMENT OF FRACTURES

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THE numerous experiments carried out during the past few years have served to clarify many problems in human metabolism, especially those of the pathology of callus formation. Many causes are known for the failure of normal healing of fractures: among them are faulty juxtaposition of the fragments, due to imperfect reduction of the fracture or interposition of soft parts. There are other causes due to changes in organic equilibrium which may impede or retard osseous consolidation in cases which, in themselves, seem favorable for healing. When these occur, it is possible to establish the cause of non-union in many cases, and at times to predict it, especially when an infectious process can be suspected, either a local or a general one, and particularly one of a tuberculous or syphilitic nature; but in others the cause is more complex, and depends on trophic changes concerning which we have only an imperfect knowledge. At present, much attention is being directed to those cases in whom the absence or retardation of callus has no apparent cause, or is associated with changes in those internal secretions which govern calcium metabolism, or with vitamin deficiencies, or with osteomalacia, or other affections more rare but of no less importance.

The experiments of Israel, Hintze, and Katzenstein have shown conclusively the important rôle which the internal secretions may play in calcium metabolism in fractures, in that they showed clinically and experimentally that an altered ovarian function produced marked changes in the consolidation of osseous callus. The function of the parathyroids has been shown to be

very important in processes of osseous repair; defects in the bone may result. Oga-wa, Huepper and others have shown that in parathyroidectomized animals the consolidation of the callus is greatly delayed and may in some cases not take place at all.

Analogously, the condition of vitamin balance is of great importance in the behavior of callus. Israel and Fränkel have shown experimentally that a diet deficient in Vitamin C may produce a marked delay in ossification of callus, whereas the administration of this vitamin in excess was of great value in consolidating a callus (Schilowwew). The use of antirachitic Vitamin D may have a favorable effect, as was shown by Ferrero in rabbits treated with irradiated stearin, which contains a high percentage of antirachitic vitamin. In this field, however, it is not possible to draw definite conclusions, as many of the experiments are incomplete or insufficient to establish finally in what forms and to what degree antirachitic vitamin may be effective. And this is easily understood, as in many cases we do not know the mechanism underlying many of these bone dystrophies, nor do we know exactly the nature and the properties of the vitamins. Nevertheless, modern practice advises in cases of slow callus formation the use of calcium preparations of various composition, with the idea of bringing into the body substances which will re-establish such an endocrine balance as to give to the tissues the greatest aid in the processes of osseous repair.

Recent experiments of Schultz and M. Clevdon on phosphorus and calcium metabolism in animals on a fixed diet, but irradiated with ultra-violet or given irradiated

oils, have shown that the initial figure for calcium was doubled after treatment; similarly, the experiments of Lesne, Turpin, and Zirive on white mice irradiated with ultra-violet showed that the level of organic calcium was raised markedly. Springer and Taradieu have confirmed these experiments and conclude that ultra-violet radiations have a eutrophic action manifest all over the body, but especially in their ability to raise the total calcium level. This action, according to Mouvriquand, Bernheim, and Teohalt, is present more or less throughout the whole range of the ultra-violet radiations.

The investigations of Huldshinsky and Sachs, Worringer and Zehnter were carried out on blood calcium in spasmophilic patients who had ultra-violet treatment. They showed that, after this actinotherapy, there was a rapid increase of calcium in the blood, so that it reached normal in a short time and remained at a normal value. Similar changes were noted by Ferri in the spinal fluid of spasmophilic patients after ultra-violet treatment. Actinotherapy is, therefore, of great importance in re-establishing the calcium balance in cases of spasmophilia.

Detailed experimental observations have shown that ultra-violet produces an immediate calcemia which is due, according to Kraus and Zoudek, to a rise of the hydrogen ion concentration of the blood. This calcemic state, according to Atzler and Gunther-Lehman, is produced either by a direct action of the ultra-violet or by an indirect effect by vasodilatation and greater circulatory activity. This hyperemic stage is followed by processes of fixation of calcium and of phosphorus, probably because of the activation by ultra-violet rays of the cholesterolin in the blood; and this is, according to Windhaus, by transformation of it into Vitamin D.

Now, if the level of calcium in the blood is favorable after ultra-violet irradiation, it is logical to suppose that even the completed process of calcium fixation should be more

lively and active, and this is of especial importance in cases in which there are notable changes in calcium balance. Such considerations have led many investigators to try to combine the administration of calcium and of ultra-violet in cases having severe osseous decalcification such as occurs in osteomalacia, tuberculous processes, etc. The observations of Rosen, of Weil and Guillaumin, of Worringer, of Rothmann and others on the metabolism of calcium and its fixation by means of ultra-violet in cases with tuberculous osseous lesions, and especially the recent observations of Clavelin and Sicard on various osteo-articular affections, have shown that this theoretical conception may have a favorable application in a practical way, and the results obtained seem to recommend the method most highly.

The experimental and clinical results obtained in this field have led us to try the method on surgical cases of pathologic fracture in which the retardation in callus formation was specially well marked. To this end some investigations, both clinical and experimental, were started in the Istituto Radiologico dell'Ospedale Mauriziano, to find out to what extent the actinocalcic method might influence favorably the consolidation of pathologic fractures.

Dr. Conte, assistant at the Institute, did some experiments on rabbits in which the diaphysis of a long bone, especially the femur, was fractured by puncture in such a way that the fractures resulting were quite similar in all the animals used in the experiment. Some of these animals were taken for controls; others received intravenous injections of calcium chloride; others received ultra-violet irradiation, and still others had a combination of ultra-violet and calcium. The injections and the radiation were carried out on alternate days after the fifth day from the beginning of the experiment until the thirty-fifth day, at which time the animals were killed. At that time some of the animals had, therefore, received fifteen in-

travenous injections of calcium, others fifteen ultra-violet irradiations, and others had had fifteen applications of ultra-violet and fifteen intravenous injections. The ultra-violet treatment of the second and third groups was done simultaneously with the use of a Gallois lamp at a distance of 60 centimeters for twenty minutes daily, the animals being fastened supine with the fractured bone facing the lamp.

The intravenous injections were done into the marginal vein of the ear, which had previously been made hyperemic. The strength of the calcium chloride solution was increased progressively from 1.5 per cent to 2.5 per cent; 5 c.c. were injected at a time, a total of ten injections being given. It was not thought expedient to use solutions of greater concentration (5-10 per cent) as were used by some German experimenters. The irradiation of the animals was carried out immediately after the injections.

During the period of observation the behavior of the callus was checked up by radiographs after ten, twenty, thirty, and thirty-five days, respectively, during which time the callus had definitely consolidated.

Examination of the sets of radiographs showed, first of all, that there was no difference in the callus in the control animals compared with those receiving only the intravenous injections of calcium or only the ultra-violet treatment, but there was a definite difference in the animals which had received combined intravenous and ultra-violet treatment. The difference was to be seen at various stages of the experiment, but was especially well marked in the terminal period (thirtieth to thirty-fifth day), when the activation of the process of repair was most manifest.

Supplementing the radiologic and clinical examinations, determinations of the percentage value of calcium in the callus were made at the time the animals were killed. The difference between the weight of the dry bone and that obtained after incinera-

tion showed clearly a greater quantity of inorganic calcium in the bones of the animals which had the combined treatment. This difference averaged 4 per cent. The values have, however, only a relative worth as, in the experiment, tissues in the process of evolution and a long way from being stable were considered, but still they are a sufficient index of local calcium fixation. From the amount of the salt injected (1.6 grams), it was calculated that at most 20 centigrams were fixed in the fracture, the rest being eliminated, or stored elsewhere in the body.

These experimental observations led us to start, on our hospital service, a series of treatments with combined calcium and ultra-violet, in which we selected a series of fractures in which callus formation was retarded or defective. We carried out the first experiments by giving the calcium orally, using mostly chloride of calcium, tricalcine, and other calcium preparations, giving them in variable quantities two hours before irradiation. In a few cases, the calcium chloride was given by rectum (200 c.c. of a 5 per cent solution). The irradiations were made daily, limiting them to the injured member at the site of the fracture. A second series of patients were irradiated after they received a hypodermic injection of calcium a quarter-hour before ultra-violet irradiation. Only a few cases were given intravenous injections of calcium chloride in 1.5 per cent solution, because many patients were reluctant to take such a treatment continuously.

The cases treated confirmed the clinical and radiologic results of the experiments on animals. There was a marked activation of the process of repair during the course of the calcico-actinic treatment in those cases of retarded callus formation, not only in those that had a definite calcium deficiency, but also in those in which deficient calcification seemed to be due to some general dystrophic process. Combined treatment was more efficacious than the simple administra-

tion of calcium salts or of opotherapeutic preparations. One may mention here the experience of Blum, who showed changes in the acid-barium balance in the blood produced by the introduction of calcium salts into the circulation, changes which favored decalcification and which tended to produce the formation of bony callus. This change did not occur in Conte's cases with combined treatment, which shows that, with this technic, the fixation of calcium is rendered more active.

The administration of calcium salts hypodermically has been found to be the best of all methods and easy to carry out in definite dosage. We generally used calcium chloride 5 per cent in 5 c.c. solution; in a few cases we used serum and calcium mixed (3-4 c.c.).

Measurements of calcium absorption showed there was a rapid rise in a short time after injection, the rise lasting for a varying time up to from 3 to 4 hours. This is the best period in which to do the treatment with ultra-violet. In a few cases in which the calcium was introduced into the body directly by vein, according to the suggestion of Clavelin and Sicard, Rothmann, Weil and others, we injected 100 to 200 c.c. of 1.25 per cent solution without the patient's noting any disturbance except a tran-

sient malaise and an intense taste of lime in the saliva. The treatment with ultra-violet was given immediately after the injection.

Our observations, although few in number and rather incomplete, since in some cases we were unable to obtain a good follow-up, still have much value in showing to what extent the use of calcico-actinic therapy may help, in addition to the other methods in the treatment of fractures in those cases in which there is retardation of callus formation and lack of consolidation of it.

Further experiments are in progress to find out at what period ultra-violet irradiation is useful in delayed healing of fractures, especially in open infected fractures, and to find out whether, in these cases, the combined treatment may offer any advantages. Another group of cases is being investigated to learn if the method of combining calcium and actinotherapy is to be preferred in cases of slow callus formation to roentgenotherapy with small doses, a technic reported by Cluzet and Dubreuil, Fränkel, Köhler, Kriwsky, Salvetti, Turco and others.

In all cases the study of radiotherapy, either by roentgen or ultra-violet rays, in callus formation, assumes great importance in traumatology, and deserves most careful investigation.

RADIUM AND X-RAY TREATMENT OF MYOPATHIC AND THROMBOPENIC MENORRHAGIA

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DURING a period of ten years we have admitted to our tumor clinic 1,993 cases in the gynecological service. Included in these are 77 cases of bleeding from the uterus in patients varying in age from 17 to 70 years. Many of these patients gave a history of prolonged and varied medical treatment. Physical examination revealed no demonstrable pathology, such as newgrowth, incomplete abortion, polyps, malignancies, and so forth, but they were considered as of particular interest because they were regarded as cases of myopathic hemorrhage (72 cases) and thrombopenic purpura hemorrhagicum (5 cases).

These patients suffered from a prolongation of the menstrual periods, with excessive bleeding; some of them had periods that were protracted; a few had intermenstrual bleeding as well. In these patients the uteri were either normal in size, or were enlarged to twice the normal size but were symmetrical in outline. In some, secondary symptoms, such as anemia, prostration, or asthenia, were marked.

It is a well known fact that these bleedings may be due to derangement of the internal secretions, such as excessive ovarian function, deficiency of thyroid secretion, or derangement of the function of the pituitary hormones, or may be due to blood dyscrasia, such as infectious diseases, syphilis and so forth, and to thrombopenic purpura hemorrhagicum.

After giving careful consideration to the causative factors, and to the use of medications, such as thyroid and ovarian extracts, iron, arsenic, hemostatic serum, ceanothin and so forth, there still remain three classes

of cases which are deserving of further thought and conservative treatment. These are the bleedings which persist in spite of medication in the younger women—the menorrhagia occurring at the time of menopause, in which thyroid extract, curettage or other measures have given no relief—and thrombocytopenia, which is a clinical entity, and can be controlled by radiation treatment in some cases. It is essential in these cases, of course, that the possibility of malignant disease be eliminated by curettage and physical examination.

Clark and Norris (1), in their book "Radium in Gynecology," say that radium is specific in myopathic bleeding, but that it should be used with a great deal of discretion in young women. This coincides with Burnam's (2) belief that it is specific in these cases and is the method of choice, especially after the age of forty.

Martin (3), as well as Meigs (4), in recent papers, have laid great stress on the endocrine secretions—ovarian, thyroid, pituitary—as probable etiologic factors in uterine bleeding. This is based on studies in recent investigations of the internal secretions, and is rather clearly set forth.

The amount of radiation varies in the hands of different workers, but all are agreed that in patients of 40 years or over, a complete sterilization by irradiation, whether by roentgen ray or radium, or a combination, produces the best results. The problems of younger women, below 35, are more varied, as an effort should be made to preserve the menstrual function if possible. Small doses of radium intra-uterine, giving 300 to 500 mc.-hrs., repeated, have been suc-

cessful. However, in most of our cases in this class of patients, the dose varied from 700 to 1,400 millicurie-hours.

Of our 77 cases, 72 were classified as myopathic bleeding, of whom the four that were treated medically will not be considered in this paper, and 68 were treated by irradiation. Five fell into the class of thrombopenic purpura hemorrhagicum, the treatment of which will be discussed later in the paper. In none of these cases was tumor of the uterus or ovaries demonstrable.

There were 68 cases of menorrhagia of unknown etiology. The ages of these patients varied from 17 to 70 years, as shown in Table I. Five of these women were single, seven of the married women had had no pregnancies, in the others the number of pregnancies varied from one to fourteen, the majority having had from one to six. The blood Wassermann reaction was negative in all of these cases; the Neisser reaction was positive in two cases. Reports on scrapings at the time of curettage were as follows:

- 54 showed endometritis (31 with hyperplasia; 7 polypoid)
- 4 showed cervicitis
- 10 cases, material was insufficient for diagnosis, or no section was obtained.

TREATMENT

The treatment administered consisted of external radiation by high voltage roentgen rays at 80 cm. distance, filter 0.5 mm. copper, 1 mm. aluminum, size of field 20×20 cm., two fields, one anterior and one posterior. It was given in two or four sittings, on successive days. There was little, if any, disturbance, such as nausea, vomiting, or loss of time, from this method. The factors varied according to the thickness of the patient, an effort being made to put 40 to 50 per cent in the ovaries. The same factors were used for "temporary sterilization" in

which 28 to 35 per cent was administered to the ovaries. This was particularly applied to patients below the age of 35, in whom an effort was made to control bleeding, with the hope that menstruation would re-establish itself. Radium tubes were usually used in tandem, inserted into the body of the uterus, filtered through 0.5 mm. gold, 0.5 mm. brass, and 1 mm. rubber, varying according to the distance of the tubes from the ovaries, from 700 to 2,000 millicurie-hours. In cases recorded as having been treated by a combination of radium and external radiation, radium was inserted and allowed to remain for periods of from 700 to 1,400 mc.-hrs., and the total dose supplemented externally by 25 per cent of the skin dose in the ovary, administered by high voltage roentgen rays. These treatments were administered at the time of curettage, which was precautionary, so that malignancy of the fundus would not be overlooked.

RESULTS

Of 68 cases of myopathic bleeding—

- 10 cases treated by roentgen ray and radium
- 2 were lost trace of immediately after treatment
- 8 cases stopped bleeding at once, and there has been no return of menstruation.
- 3 cases were treated by roentgen ray alone
- 1 was lost trace of immediately after treatment
- 1 (age 27) stopped bleeding at once, but normal menstruation was reestablished within the year and she has had three subsequent pregnancies which terminated in three normal children
- 1 stopped bleeding in one

month, with no return of menstruation.

55 cases were treated with from 700 to 2,000 mc.-hrs. of radium inserted into the uterus

4 were lost trace of immediately after treatment

51 stopped bleeding at once. In five cases, 35 years of age and under, normal menstruation was reestablished.

Of the 11 patients who were 35 years of age or less, three were lost trace of immediately after treatment; one, treated with roentgen rays, re-established normal menstruation; five, treated with radium, re-established, and two, treated with radium, did not re-establish menstruation.

Besides these 68 cases of myopathic bleeding there were five cases with rather typical and similar histories of black and blue spots appearing without provocation, and of prolonged menstrual periods, in three cases almost continuous bleeding. In only one of these was there a definite enlargement of the spleen. The ages of these women were from 24 to 31 years, all were married, and all had been pregnant, from one to seven times. In all of these cases the blood platelet count varied from 76,000 to 124,000 before treatment. The bleeding time was prolonged and there was poor retraction of the clot.

TREATMENT AND RESULTS

One case was treated with roentgen rays, over the lateral spleen only, 30 per cent, followed in two and a half months by 20 per cent. A good result was obtained in this case. The patient had cessation of bleeding, with re-establishment of normal menstrual periods in eight months.

One case was treated with high voltage roentgen rays, 25 per cent over the spleen and 25 per cent over the ovaries, and one month later radium tubes intra-uterine, 1,439 millicurie-hours. She has had no bleeding since the last treatment, and is now feeling well.

One patient who had 28 per cent roentgen rays over the ovaries, re-established normal menstrual periods in four months and is feeling well.

One patient who had bleeding two weeks after 30 per cent roentgen ray had been given over the ovaries, was subjected to splenectomy three months after treatment.

One case was given 54 per cent roentgen ray over the ovaries, and radium tubes were inserted intra-uterine for 915.7 millicurie-hours. Following this, she had severe hemorrhages at times, and two months later was given 25 per cent over the spleen. Rather severe bleeding recurred and three and a half months later 54 per cent was given over the ovaries. She complained bitterly of menopausal symptoms, bleeding

TABLE I.—AGE INCIDENCE AT THE TIME OF ADMISSION

Myopathic bleeding

Age period	17-19	20-29	30-35	36-39	40-49	50-54	55-59	60-70
No. cases...	2	5	4	3	35	9	4	6

Thrombopenic purpura hemorrhagicum

Age	24	27	30	31
No. cases	1	1	2	1

having ceased two months after the last treatment. She also had a small fibroid.

CONCLUSIONS

1. Of 68 cases of myopathic menorrhagia, treated by irradiation, 61 were followed and were cured.

2. There was no mortality in the treatment of these cases by irradiation.

3. Five cases were diagnosed as thrombopenic purpura hemorrhagicum. Four were controlled with irradiation alone; one was subjected to splenectomy.

4. A thorough blood examination is essential in the diagnosis of this condition, in all cases in which there is no demonstrable gross pathology.

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ELECTRICAL DEFINITIONS DEALING WITH THE SUBJECT OF RADIOLOGY

These definitions have been prepared under the supervision and are published with the approval of the Sectional Committee on Electrical Definitions of the American Standards Association: Sponsor, American Institute of Electrical Engineers, A. E. Kennelly, of Harvard University, Chairman, and H. E. Farrer, of New York City, Secretary. The Subcommittee Chairmen are as follows:

No. 1. *General (Fundamental and Derived Terms)*: H. L. Curtis, Bureau of Standards, Washington, D. C.

No. 2-A. *Rotating Machinery*: C. V. Christie, McGill University, Montreal, Quebec, Canada.

No. 2-B. *Transformers*: R. C. Sogge, General Electric Company, Schenectady, New York.

No. 3-A. *Switching Equipment*: H. E. Ruggles, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania.

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No. 14. *Electrobiology*: M. G. Lloyd, Bureau of Standards, Washington, D. C.

These definitions, the Subcommittee Chairman wishes it understood, are submitted tentatively, and he will be glad to receive suggestions from readers of RADIOLOGY.

GENERAL TERMS

Radiology: Radiology is the science and application of roentgen rays, radium rays, or other high frequency rays.

Radiologist: A radiologist is a medical specialist in employing roentgen rays and/or radio-active substances.

Röntgenology: Roentgenology is the diagnostic application of roentgen rays.

Röntgenography (Radiography): Roentgenography is the art of producing radiographs.

Radiation: Radiation is the radiant energy emitted by an X-ray tube, by radio-active substances, or by other sources.

Röntgenogram (Skiagraph, Skia-gram*)*: A roentgenogram is a photographic record of the relative transparency of the various parts of an object to roentgen rays.

Radiograph (Radiogram)*: Radiograph

*Asterisk applied to synonym means that its use is deprecated.

is a record produced on a photographic plate, film, or paper by the action of roentgen rays or radium.

Fluoroscopy: Fluoroscopy is the use in diagnosis, testing, etc., of a fluorescent screen which is activated by roentgen rays.

KINDS OF RAYS

Roentgen Rays (X-rays) Roentgen rays are electromagnetic waves of very short wave length which are set up when the velocities of electrons are altered suddenly.

According to the quantum theory of the nature of radiation, roentgen rays are particles of energy (quanta) travelling linearly at the velocity of light.

NOTE.—“Roentgen rays” is preferred by medical authorities, but “X-rays” is in more general use by physicists. The wave lengths concerned are usually between 0.006 and 1.0 millimicron.

Secondary Roentgen Rays: Secondary roentgen rays are the roentgen rays emitted in all directions by the matter upon which a beam of roentgen rays impinges.

Scattered Roentgen Rays: Scattered roentgen rays are roentgen rays which, during their passage through a substance, have been deviated in direction and also may have been modified by an increase in wave length.

Characteristic Roentgen Rays (Characteristic Spectra): Characteristic roentgen rays are roentgen rays having wave lengths determined by the chemical constitution of the object which emits, transmits, or scatters them.

Fluorescent Roentgen Rays: Fluorescent roentgen rays are secondary rays whose wave lengths are characteristic of the substance which emits them.

Cathode Rays: Cathode rays are streams of electrons emitted from the cathode of an evacuated tube normal to its surface, under the influence of an applied voltage.

NOTE.—By suitable means they can be brought outside of the tube.

Lenard Rays: Lenard rays are cathode rays which have passed outside the discharge tube.

Positive Rays (Canal Rays): Positive rays are streams of positively charged atoms travelling at high speed from the anode of a partially evacuated tube, under the influence of an applied voltage.

PHYSICAL AND INDUSTRIAL APPLICATIONS

Radiometallography: Radiometallography is the radiography of metals.

X-ray Crystallography: X-ray crystallography is the study of the arrangement of the atoms in a crystal by the reflection of X-rays from the atoms of the crystal.

Filtration of Roentgen Rays: Filtration of roentgen rays is the absorption of some of the relatively longer wave lengths of X-ray radiation by placing in its path some absorbing medium such as aluminum.

X-ray Spectrum: X-ray spectrum is the spectrum of a heterogeneous beam of roentgen rays produced by a suitable grating, frequently a crystal.

Minimum Wave Length (Quantum Limit): Minimum wave length is the shortest wave length in an X-ray spectrum. It is definitely related to the maximum voltage applied to the X-ray tube in accordance with the Planck-Einstein quantum equation.

Absorption Coefficient: Absorption coefficient is the ratio of the linear rate of change of intensity of roentgen rays in a given homogeneous material to the intensity at a given point.

Half Value Thickness (Half Value Layer): Half value thickness is the thickness of a given substance which, when introduced in the path of a given beam of rays, will reduce its intensity to one-half of the initial value.

MEDICAL TERMS

Radiotherapy: Radiotherapy is the treatment of disease by the application of roent-

gen rays or the rays from radio-active substances.

Roentgenotherapy: Roentgenotherapy is the treatment of disease by roentgen rays.

Radium Therapy: Radium therapy is the treatment of disease by the use of radium.

Irradiation (Raying): Irradiation is the prolonged application of roentgen rays, radium rays, or other radiation to a patient or other object.

TUBES

Discharge Tube: A discharge tube is a vessel of insulating material (usually glass) provided with metal electrodes, which is exhausted to a low gas pressure and permits the passage of electricity through the residual gas when a moderately high voltage is applied to the electrodes.

Gas Tube: A gas tube is an X-ray tube which depends for its action on the presence of residual gas in the tube, and in which the target is usually connected electrically to the anode.

Vacuum Tube: A vacuum tube is a vessel of insulating material (usually glass) provided with metal electrodes, which is exhausted to a high degree of vacuum.

X-ray Tube: An X-ray tube is a discharge tube or vacuum tube suitable for the production of roentgen rays.

Cathode-ray Tube (Lenard Tube): A cathode-ray tube is a vacuum tube with a thin window at the end opposite the cathode to allow the cathode rays to pass outside.

Geissler Tube: A Geissler tube is a special form of discharge tube for showing the luminous effects of discharges through rarefied gases.

NOTE.—The density of gas is roughly one-thousandth that of the atmosphere.

Crookes Tube: The Crookes tube is an early form of discharge tube devised by Sir

William Crookes and used by him for the study of cathode rays.

NOTE.—The density of gas is roughly one-millionth that of the atmosphere.

Hot Cathode Tube: A hot cathode tube is a vacuum tube in which the cathode is electrically heated to incandescence.

Coolidge Tube: A Coolidge tube is a hot cathode X-ray tube in which the vacuum is so high that the residual gas plays no part in the production of the cathode rays.

Target (Anode, Anti-cathode)*: A target is the metal or plate on which the cathode rays are focussed and from which the roentgen rays are emitted.

Cathode Dark Space—Crookes Dark Space: Cathode dark space is the non-luminous region which envelops and follows the outline of the cathode in a discharge tube at moderately low pressures.

Negative Glow: Negative glow is the luminous glow which envelops the cathode in a discharge tube at moderately low gas pressure.

Kenotron (Valve Tube): A kenotron is an electric valve consisting of a vacuum tube having for one electrode a hot filament.

Thyratron: A thyratron is a form of discharge tube containing mercury vapor and a multiplicity of electrodes, used as an electric valve or to rectify alternating currents.

OTHER APPARATUS

X-ray Machine: An X-ray machine is the transformer, rectifying switch (if any), filament transformer, and controls used in connection with an X-ray tube.

X-ray Apparatus: X-ray apparatus is an X-ray tube and its accompanying accessories, including the X-ray machine.

Electrostatic Generator (Influence Machine, Static Machine, Wimshurst Machine): An electrostatic generator is a gen-

erator which depends upon electrostatic action.

Induction Coil (Coil, Spark Coil, Ruhmkorff Coil): An induction coil is a transformer with open magnetic circuit which is excited by an interrupted or variable unidirectional current.

Interrupter—Break (of an Induction Coil): An interrupter is a device for interrupting the primary current mechanically or otherwise.

Fluorescent Screen (Fluoroscope): A fluorescent screen is a sheet of suitable material coated with a substance which fluoresces visibly when roentgen rays, radium rays, or electrons impinge upon it.

Intensifying Screen: An intensifying screen is a thin screen, coated with a finely divided substance which fluoresces under the influence of roentgen rays, and intended to be used in close contact with the emulsion of a photographic plate or film for the purpose of reinforcing the image.

X-ray Spectrometer: An X-ray spectrometer is an instrument used for determining the wave length of roentgen rays.

Ionization Chamber: An ionization chamber is an enclosure containing two or more electrodes between which an electric current may be passed when the enclosed gas is ionized. It is commonly used for determining the intensity of roentgen rays and other rays.

Penetrometer (Qualimeter, Radiosclerometer): A penetrometer is an instrument for determining the hardness of roentgen rays.

Dosage Meter (Intensimeter): A dosage meter is an instrument for determining the exposure when using roentgen rays for medical treatment.

Oscilloscope: (a) An oscilloscope is an auxiliary discharge tube in which the length of the negative glow affords an indication of the amount of current passing. (b) An oscilloscope is an evacuated tube containing two electrodes, the glow surrounding which

indicates whether the high potential applied is direct or alternating. (c) An oscilloscope is a cathode-ray oscillograph with linear time-axis.

CHARACTERISTIC TERMS

Hardness—Quality (of roentgen rays): Hardness is the penetrating ability, depending on wave length, of roentgen rays. The shorter the wave length, the harder the rays and the greater their penetrating ability.

Hardness (of a gas tube): Hardness is the degree of rarefaction of the residual gas.

NOTE.—The higher the vacuum, the higher the voltage required to cause a discharge with a cold cathode, and hence the shorter the wave length of the resulting roentgen rays.

Intensity (of roentgen rays): Intensity is the X-ray energy passing per unit time through unit area normal to the direction of propagation.

Quantity of Roentgen Rays (Quantity of X-radiation): Quantity of roentgen rays is the product of intensity, time, and cross-sectional area of the beam.

Roentgen (r Unit):* Roentgen is the international unit of quantity of roentgen rays adopted by the Second International Congress of Radiology at Stockholm in 1928. It is the quantity of X-radiation which, when the secondary electrons are fully utilized and the wall effect of the chamber is avoided, produces in one cubic centimeter of atmospheric air at 0°C. and 760 mm. of mercury pressure, such a degree of conductivity that one electrostatic unit of charge is measured at saturation current.

TERMS NOT OTHERWISE CLASSIFIED

Ionization: Ionization is the liberation of electrons from the atoms of a gas.

Ionization Current: Ionization current is

the movement of electric charge produced by the action of an electric field upon an ionized gas.

DEFINITIONS OF TERMS IN ELECTROBIOLOGY,
INCLUDING ELECTROTHERAPEUTICS
(GENERAL)

Electro-culture: Electro-culture is the stimulation of growth, flowering, or seeding by electrical means.

Electrodiagnosis: Electrodiagnosis is the determination of the effect of electric stimulation of nerves, muscles, and organs, and of the electrical resistance of the body.

Electrocution: Electrocution is the taking of life by means of electric current.

BIOLOGICAL TERMS

Electrocardiogram: Electrocardiogram is a graphic trace of the electric current produced by the contraction of the heart muscles.

Galvanotaxis: Galvanotaxis is the tendency of a living organism to arrange itself in a medium so that its axis bears a certain relation to the direction of the current in the medium.

Galvanotropism: Galvanotropism is the growth or bending of a living organism into a certain relation with an electric current.

Electrotonus: Electrotonus is the condition of a nerve or muscle beyond and between the two electrodes when a voltaic current is applied to a portion of its length.

Anelectrotonus: Anelectrotonus is the condition of a nerve or muscle near the anode, and is characterized by flow of current toward the portion to which the electrodes are applied.

Catelectrotonus: Catelectrotonus is the condition of a nerve or muscle near the cathode, and is characterized by flow of current away from the portion included between the electrodes.

Neuro-electricity: (a) Neuro-electricity is electric current generated in the nervous system. (b) Neuro-electricity is a form of energy resembling, but not identical with, electricity.

ELECTROTHERAPEUTIC TERMS

Electrotherapy: Electrotherapy is the treatment of disease by means of electricity.

Electrotherapist: An electrotherapist is a medical graduate who has had special training and has acquired skill in the therapeutic use of electricity.

Electric Sleep: Electric sleep is anesthesia produced by means of Leduc currents.

Electrocoagulation: Electrocoagulation is coagulation by means of a high frequency electric current.

NOTE.—The heat producing the coagulation is generated within the tissue to be destroyed. By this method tissue can be destroyed to any desired depth.

Diathermy: Diathermy is the therapeutic use of a high frequency current to generate heat within some part of the body.

NOTE.—The frequency may be from 750,000 to 3,000,000 cycles per second.

Autocondensation: Autocondensation is a method of applying high frequency currents for therapeutic purposes in which the patient constitutes one plate of a capacitor.

Autoconduction: Autoconduction is a method of applying high frequency currents for therapeutic purposes by electromagnetic induction, the patient being placed inside a large solenoid and constituting the secondary of a transformer.

High Frequency Treatment (D'Arsonvalism): High frequency treatment is the therapeutic use of very high frequency intermittent and isolated trains of heavily damped oscillations of very high voltage and relatively low current.

Faradism: Faradism is the therapeutic

use of an interrupted current for the stimulation of muscles and nerves. Such a current is derived from an induction coil, usually from the secondary, though occasionally from the primary.

Galvanism: Galvanism is the therapeutic use of direct current.

Phoresis: Phoresis is the transmission of chemical ions into the tissues by means of an electric current.

Cataphoresis: Cataphoresis is the transmission of electronegative bodies into the tissues by the passage of an electric current. The flow is toward the negative pole.

Medical Ionization (Ionic Medication): Medical ionization is the therapeutic use of an electric current for the purpose of introducing ions of soluble salts into the tissues.

Fulguration: Fulguration is the destruction of animal tissue by high frequency electric sparks whose action is controlled by a movable electrode.

KINDS OF DISCHARGE

Brush Discharge: Brush discharge is the discharge from a static machine (or less commonly from a high frequency apparatus) having a disruptoconvective character.

Convective Discharge: Convective discharge is the discharge through the air from a high voltage source in the form of visible or invisible streams of charged particles.

Disruptive Discharge: Disruptive discharge is a passage of current through an insulating medium due to the breakdown of the medium under the electrostatic stress.

Effluve: Effluve is a convective discharge of a high voltage current through a dielectric.

Static Breeze (Static Brush): Static breeze is the brush discharge as used in therapy.

KINDS OF CURRENT

Static Induced Current: Static induced current is the charging and discharging cur-

rent of a pair of Leyden jars or other condensers, which current is passed through a patient.

Galvanic Current: Galvanic current is a steady, direct current.

Leduc Current: Leduc current is an interrupted direct current, each pulse of which is approximately of the same current strength and same duration.

Faradic Current: Faradic current is an intermittent alternating current obtained from the secondary winding of an induction coil.

D'Arsonval Current: D'Arsonval current is a high frequency, low voltage current of comparatively high amperage.

Oudin Current: Oudin current is a high frequency current of very high voltage.

Tesla Current: Tesla current is a high frequency current having a voltage which is high, but intermediate between an Oudin current and a D'Arsonval current.

Morton Wave Current: Morton wave current is an interrupted current obtained from a static machine by applying to the part to be treated a flexible metal electrode connected to the positive terminal of the machine, the negative terminal being grounded.

Direct Vacuum-tube Current: Direct vacuum-tube current is a current obtained from a static machine by applying to the part to be treated a vacuum electrode connected to one terminal of the machine, the other terminal being grounded.

APPARATUS

Electrophorus: Electrophorus is a non-rotating apparatus for obtaining static electricity by means of induction.

Oudin Resonator: Oudin resonator is a coil of wire of adjustable number of turns which is designed to be connected to a source of high frequency current, such as a spark gap and induction coil, for the purpose of applying an effluve to a patient.

Spark Ball: Spark ball is an insulating handle having at one end a metallic ball for use in applying static sparks.

Point Electrode: Point electrode is an insulating handle having at one end a metallic point for use in applying static sparks.

Detonating Chamber: A detonating chamber is a muffler surrounding the discharging balls of a static machine or reson-

ator for deadening the sound of a spark discharge.

Electrocautery: Electrocautery is an apparatus for cauterizing tissue, consisting of a holder containing a platinum wire, which may be heated to a red or white heat by a current of electricity.

Hook-up: Hook-up is the arrangement of circuits, electrodes, and apparatus used in giving any particular treatment.

MEDICO-LEGAL DEPARTMENT

THE MEDICAL EXPERT WITNESS

By I. S. TROSTLER, M.D., F.A.C.R., F.A.C.P., CHICAGO

THERE is probably no occasion or position in which the average physician finds himself at a greater disadvantage than when he is called upon to appear in court as an expert witness. This applies, however, only to those unaccustomed to this service, and not to those who are more or less frequently called upon to act in this capacity.

As long as courts exist and litigants are unable to agree on controversial matters, and where there is a lack of or difference in opinions relative to the normal, pathologic, or anomalous anatomy, function, structure, appearance in health, disease or death, cause of death, etc., physicians will be needed as expert witnesses for the purpose of clearing up moot, debatable, or disputed questions, and to enlighten the court and jury upon these subjects in which they are supposed to be learned and, because of such learning, to be authorities.

Litigation involving health and personal injury, employer's liability and the like, is greatly on the increase, and, because of this, the medical expert witness is becoming more and more in demand.

With courts functioning as they do at the present time, expert medical testimony is practically a necessity, and it devolves upon those best fitted to give such testimony to be well prepared to supply that need. Because so many of the better class of medical men have held themselves aloof and declined to appear as expert witnesses, much of this has fallen into the hands of professional expert witnesses—much to the decided disparagement of the medical profession and, sad to

say, considerably to its derision by the legal profession.

I have heard lawyers say—and I do not doubt it in the least—that they can easily get medical expert testimony to prove anything, any way they may want it proven, and it is a fact, within my own observation, that some physicians (professional expert witnesses) will qualify and testify as surgeons in one court, an hour later as pediatricians in another court, and as psychiatrists in a third court, all within three hours and in adjoining court rooms. I have said about several of these men, that they are specialists on the skin and *its contents*.

To those who are temperamentally and professionally properly qualified to testify as medical expert witnesses, and have made, or are willing to make, a study of this branch of medical service, there are in the larger cities opportunities to be a credit to the medical profession, and at the same time earn remunerative fees without being called out nights, required to keep up expensive establishments, employ high salaried help, etc.; but, if this is undertaken in a conscientious manner, no more exacting line of practice can be projected.

The ideal medical expert witness is a physician who has built up a professional and personal reputation for honesty of character and integrity of purpose, who is widely known and well informed on general medicine, and has a standing beyond any cavil or question in his specialty. Such a man should have a good control of language, a fairly large vocabulary, and be able to express himself clearly. He should, of course, have a

good memory and be able to repeat what he has said on direct examination, a few minutes before. He should be able to answer a question and stop after he has answered it, without going into a history of the last century to qualify his answer. He should have enough perception and knowledge of reading human character to be able to see ahead and possibly anticipate, in his own mind, the point toward which the lawyer questioning him is leading, and he should be keen enough and sure enough of his knowledge not to be trapped into contradiction of his previous statements.

ORIGIN OF MEDICAL EXPERT TESTIMONY

So far as we are able to learn, the calling of physicians as expert witnesses originated in England about 1350, when, during the trial of a criminal, it was found necessary to determine whether a certain injury constituted mayhem, and a physician was called to examine the injured person and testify as to his findings and to render an opinion. This experimental use of expert testimony proved to be so enlightening, added so much to the clarity of the situation, and proved to be so informing that it soon became the custom. Since that time medical expert testimony by physicians has probably been more called to assist the courts and juries to understand technical matters, than has any other class of expert witness.

DISAGREEMENTS AND CONTRADICTIONS

The tendency of litigants, claim departments of insurance organizations, and attorneys (on both sides, of course) is to try to conceal all of the information each side may possess, *which if not concealed might help the expert witnesses to further and aid justice.* But hiding as much as they can of the facts which they fear might damage their side of the case, only a portion of

the facts are exposed and revealed to the expert witness, at the time that the questions are asked him, his answers elicited, and his opinions go into the testimony in the case. Then the other side presents its evidence, with as much or as little as it feels like revealing, and gets another expert to give an opinion, which because of the manner of asking the questions, as well as the amount of information given, may be diametrically opposite to the opinion and evidence given by the previous witness, although if both were asked the same questions under the same conditions, they would agree in every detail. In that way, the lawyers make us out to be contradictory, incongruous, and given to *denying the truth of one another's statements.*

A WITNESS SHOULD NOT APPEAR TO BE AN ADVOCATE

Expert witnesses should not appear to take sides in the trials in which they testify, and not in any sense to appear to be advocates. Their only duty should be to give their opinion when asked for it, and to answer the questions which they are asked. Any appearance of advocacy or tendency to champion the cause of either side or become controversial, will lead any open-minded and fair jury to immediately conclude that the witness is taking sides, and his testimony will at once be discounted, and the credence originally given it be markedly lowered or even rendered worthless. We have seen expert witnesses so anxiously trying to create favorable testimony for the side for which they were appearing, that they were almost as bad as the "Alibi Ike," who was ready to swear that he was at lodge, when he was playing poker.

PHRASEOLOGY

Many medical expert witnesses, in an evident effort to create the impression that they

possess great erudition and learning, make use of ponderous, ultra-technical, polysyllabic phraseology, much of which is not understood by any one except the speaker. This effort to throw up a cloud of scientific hokum, to impress their hearers with their great erudition, is usually successful as far as that purpose is concerned, but it does not as a rule help the cause, or clear up the seriously puzzling problem which is the reason for their being there. If medical expert witnesses would give their testimony as nearly as possible in words of one syllable, their testimony would be much better understood, more convincing, and much more useful in furthering the cause of justice.

The average juror knows little or nothing about anatomy or anatomical phraseology, so when a physician mentions the proximal extremity of the third metatarsal bone, or the mediolateral aspect of this or that, it means but little to him; whereas, if the witness had spoken plainly and in ordinary, common language, he might have helped and done some good. To go farthest and serve best, all testimony should be couched in language understandable by the most ignorant person on the jury.

OPINION EVIDENCE AND TESTIMONY

While it is a general rule that opinions of witnesses are considered to be incompetent for evidence, and that witnesses shall not be and are not allowed to express opinions while testifying, this rule is not operative when it is applied to the evidence of expert witnesses, and to what is commonly known as expert testimony. However, expert testimony is admissible in only a certain class of cases; that is, in cases wherein the subject matter of the issue of the case involves questions beyond the range of ordinary knowledge and experience, wherein persons without particular experience or special study would be unable to determine, or in-

capable of formulating a correct opinion relative to the matter or a correct judgment thereon.

Because of these reasons, the opinions of specially trained persons appearing as expert witnesses are declared by the courts and authorities on jurisprudence to be admissible as evidence. In the language of former Chief Justice Shaw, this is "because a man's professional pursuits, his technical skill, and knowledge of science not common to men in general, enable him to draw an inference where men of common experience, after all the facts are proved, would be left in doubt."

When knowledge of the physical or mental condition of some individual becomes important or particularly desirable in a lawsuit, it will readily be seen that facts are liable to be presented which may cause serious questions to arise, which the jury will be incapable of deciding or comprehending, and necessitating the knowledge and experience of a physician for their comprehension and elucidation.

QUALIFYING EXPERT WITNESSES

It must be understood that, because of the technical character of expert medical testimony physicians are expected to give, the witnesses must, before being permitted to give such testimony, show sufficient and satisfactory qualifications to fit them to pass upon the medical matter in question. Therefore, medical expert witnesses, in common with other expert witnesses, are usually asked more or less extended questions appertaining to their knowledge, experience, and qualifications along the lines in which their testimony is to be given.

Often this qualifying examination is comparatively brief and not at all exhaustive, but it is a general rule that any physician appearing as an expert witness is asked questions sufficient to place clearly be-

fore the court and jury his status as a specialist of large experience.

Sometimes, large and extensive experience and specialization are not necessary or required. In some States, one need not be a psychiatrist or specialist in diseases of the mind to give expert testimony as to sanity or insanity. The Supreme Court of Nebraska (in 180 N. W. R. 567) decided that a physician in general practice, who has had experience in cases of insanity, may be entitled to testify on the question of insanity, although he may not be a neurologist or psychiatrist. A similar decision comes from the Supreme Court of Missouri (225 S.W.R. 941).

As a general rule, however, it is necessary to satisfy the court that the witness has the necessary qualifications as an expert, unless the attorneys for both sides agree to accept the qualifications of the witness. This is frequently done by agreement between attorneys, if the witness or his qualifications are well known.

It is also within the province and rights of the presiding judge in some States to refuse to permit a witness to qualify as an expert witness. I have known of professional expert witnesses whose testimony was so notoriously for sale as to have been so refused. There are a few such "black sheep," and it is a good thing that their coats are so colored that they cannot be bleached.

DISCLAIMER OF QUALIFICATIONS

A medical witness may disclaim qualifications as an expert and thereby disqualify his opinion as evidence. According to opinions rendered by Supreme Courts in Mississippi, West Virginia, Massachusetts and several other States, a general practitioner has been held not qualified as an expert witness, to the extent of answering questions pertaining to some special branch of medicine to which he has given no special study and concerning

which he has had neither experience nor observation. Disclaimer of qualifications to testify on the subject of the interrogation by the witness himself, renders his testimony upon that particular subject incompetent and inadmissible.

EXPERTS MUST NOT USURP THE FUNCTION OF THE JURY

Probably the first and most important principle involved governing the introduction of opinion evidence is that the witness must not so testify as to assume the duty of or trespass upon the functions of the jury. For example, the questions asked the witness upon which he is expected to pass his opinion must not be the exact questions which it is the duty of the jury to decide; thus the expert witness must not be asked if in his judgment, based upon the testimony introduced in the case under trial, certain conditions exist, because that would be a matter for the jury to weigh and decide. "It is the function of opinion evidence to assist the jury in arriving at a correct conclusion upon a given state of facts" (180 N.W.R. 815).

HYPOTHETICAL QUESTIONS

The usual manner of ascertaining the opinion of the expert, without permitting him to assume the function of the jury and to pass upon the facts, is the formulation of a question containing the evidence upon which the party to the suit relies, and the truth of which is assumed, for the witness to answer. This is the so-called hypothetical question, which, supposedly embodying the salient and most important points and parts to the desired extent, is propounded to the expert witness and is to be answered by him according to his knowledge and experience.

The attorneys usually frame this type of

question most carefully, setting forth hypothetically all the points upon which they desire the opinion or answer of the expert to be based. The theory of the hypothetical question is that it contains only essential facts of the case, so that when an expert witness is asked an hypothetical question which contains assumed facts, or statements which are not supported or proven by the evidence, there is liable to be an immediate objection by the opposing attorney to the witness answering the question, and if the objection is sustained by the trial judge, no answer is given. It has been held by numerous capable trial judges, and confirmed by higher courts, that if one statement included in the hypothetical question, and therefore supposed to be true, is untrue and not supported by the evidence, the answer and opinion of the entire hypothetical question will be valueless (226 S.W.R. 137).

Expert witnesses do not in all cases testify upon hypothetical statements of facts alone. If the physician has attended a patient whose case is on trial, and understands his condition, he is a proper witness to state such facts and conditions, and after having stated such facts and conditions to the jury he may as an expert express an opinion thereon, provided, of course, that the statutes of the State wherein the trial of the case is held do not provide for and declare that the knowledge acquired by a physician while attending a patient is privileged, and that the patient has not waived the privilege.

The court and jury have a right to know upon what the opinion of the expert witness is based, so that it is an established rule that the presiding judge, the jury, nor the attorneys for either side of the case on trial may ask the expert witness the reason for which his answer was given, and upon what his opinion was based; or the witness may, with permission of the court, explain why his answer or opinion is so given. Details such as these are usually gone into during cross-examination, at

which time the witness may be asked any question tending to test his credibility, accuracy, and memory. He may be compelled to answer questions even though they may tend to injure his character and reputation, except when the answer would contribute to his own incrimination.

An old—but still recognized—authority, entitled, "Rogers on Expert Testimony," lays down rules governing the examination of expert witnesses, as follows:

First, Evidence should be confined to the points in issue, and evidence of collateral facts which are incapable of affording any reasonable presumption as to the principal matter in dispute, should not be received.

Second, Leading questions should not be asked on the direct examination, but may be asked on the cross-examination of a witness. [This may be subject to exception when and where the subject matter of the evidence is complicated and usually does not apply when the witness is hostile.]

Third, In England the rule is that the direct examination and the cross-examination of a witness must relate to the facts in issue, or relevant or deemed to be relevant thereto, while the re-direct examination must be directed to an explanation of the matters referred to in the cross-examination. But in this country the weight of authority is in favor of confining the cross-examination of the witness to the facts testified to in chief. The English rule has been substantially adopted in Massachusetts, Missouri, and South Carolina. In Michigan the English rule has been acted on in practice, and the rulings of the Supreme Court of that State are as liberal as those of the Supreme Court of Massachusetts on the same subject.

Fourth, On cross-examination, a witness may be asked any question tending (1) to test his accuracy, veracity, and credibility, or (2) to shake his credit by injuring his character. And he may be compelled to answer the same, unless such answer would tend to incriminate himself.

Fifth, If, on cross-examination, a witness is

asked a question which is irrelevant only in that it may tend to shake his credit by injuring his character, his answer cannot be contradicted unless, (1) he has denied facts tending to show that he is not impartial, or (2) he has been asked and has denied or refused to answer whether he has been convicted of some criminal offense.

Sixth, The court, in its discretion, may permit a witness to be recalled for further examination. If permission is granted for further examination-in-chief, or further cross-examination, the parties have the right of further cross-examination and of further re-direct examination, respectively.

Seventh, On cross-examination, a witness may be asked as to any former statements which he may have made, and which are inconsistent with his present testimony. If he denies having made them, they may be proven against him.

Eighth, A party is entitled to the cross-examination of a witness who has been (1) examined-in-chief, or (2) according to the English rule, if he has been intentionally sworn.

WEIGHT OF EXPERT EVIDENCE

The effect, credence, and force which are to be given to expert evidence by the jury, in the course of its deliberation, is a question upon which the courts of the several States in this country have been at considerable variance.

A well-recognized line of discussion is to the effect that expert evidence should be received with caution, because, being merely an expression of opinion, it is not entitled to receive the same weight as the testimony of an eye-witness to a fact within his knowledge. This was most clearly put, when the trial judge in a New York case, in his instruction to the jury, said: "When a physician testifies in regard to a fact, you are to believe it just as you are to believe any other man of equal credit. When they tes-

tify to a fact that they know from their study of diseases, and their characteristics, and tell us what there is of the facts, you are to believe it. But when they testify in regard to opinions, it becomes a different question. . . . Everything that these physicians testify to as matters of observation, and by which they are able to tell you the characteristics of the disease, you are to believe as facts, as you would otherwise.

"In considering their testimony, you will consider, in reference to each statement, whether it is a fact or an opinion; you will apply this rule to all facts connected with the case, that are derived from the investigations of these physicians."

On the other hand, other courts have held that expert testimony should be considered like other evidence and given equal weight, while still other courts hold that expert evidence should be given little credence.

In marked contrast to the few instances in which the last expressed view is held, very many courts have stated that the opinions of physicians on medical matters should have great weight, while others have stated that opinions of physicians as to mental capacity, sanity, and insanity are entitled to no greater weight or credence than that of ordinary persons.

Although these widely varying views may seem to be irreconcilable, a careful study of the facts before the courts in the different cases, causes many of the inconsistencies to disappear. The circumstances of the cases, the widely varying conditions of the patients, the widely varying opportunities of the physicians to study the circumstances and conditions relative to which their testimony, the character of their testimony or the opinions which they are called upon to express, may be so at variance as to have an equally widely varying effect in producing these differing expressions of the expert witness's opinions.

MULTIPLICITY OF EXPERT WITNESSES

While many swallows may make summer, a multiplicity of expert witnesses may not make the side that they testify for, right and entitled to a verdict. In a widely quoted case before the Court of Civil Appeals of Texas, in which a number of physicians testified for one side and only one physician testified for the other, and the jury found for the side employing only the one physician, the Appellate Court said: "The jury clearly could accept the opinion of one expert rather than the contrary opinions of many experts. To hold otherwise would be tantamount to holding that a jury's verdict, in order to be upheld, must be in favor of the party offering the greater number of expert witnesses to testify as to its contention" (23 S.W.R. 405).

MEDICAL BOOKS IN EVIDENCE

In nearly all States in this country medical books may not be introduced as testimony or for evidence, but statements by witnesses that their testimony is based upon knowledge acquired by reading medical books are admissible and constitute competent evidence. In several instances in my own experience, extracts from medical books have been read and witnesses have been asked if they agreed with the statements and opinions of the author. Of course, this was done to discredit the witness on each occasion. This plan was once tried on me, by an attorney, who read abstracts from an old and obsolete medical book. I did not agree with the statements quoted from the book and qualified my answer by calling attention to the fact that the book was over twenty years old and that medical knowledge had advanced in that time. When later I was asked in re-direct examination as to what I based my differing opinion upon, I gave the name of a book written by a worldwide authority,

published within a year, and in which I was quoted upon the identical subject under investigation by the attorney who was trying to discredit me. The result proved that his effort and attempt to discredit me acted as a boomerang, the jury finding for the defendant, without leaving their seats.

EXPERT WITNESS FEES

When a physician has been called as an expert witness, he is entitled to a fee commensurate with his standing and prominence in his profession, and in nearly all instances he receives the same. This is particularly true if the witness has prepared himself especially, or has made special investigation.

It is true that a physician is sometimes compelled to answer a subpoena as an ordinary witness, and after his appearance on the witness stand is obliged to testify as an expert, for the statutory *per diem* and mileage; but under such circumstances only impromptu answers to the questions put to him may be demanded.

If the party for whom the expert testimony is to be given, desires that the testimony be backed up by knowledge acquired by special study and investigation, special arrangements as regards compensation should be and generally are made; and any such arrangement or contract, if made, is valid and enforceable. A physician (or other expert witness) having in good faith rendered such services, may enforce the payment for same by suit. If no definite fee has been fixed by agreement, he may recover a fair, just, and reasonable amount for his services.

The Supreme Court of Louisiana held that two physicians who were summoned from the city of New Orleans to appear in Lincoln Parish, to testify in a murder case as expert witnesses, gave their testimony and rendered a bill for \$50.00 per day plus their actual expenses. The trial court allowed them \$25.00 per day and expenses.

The physicians then appealed to the Police Jury to show cause why they should not be allowed the amounts they claimed in full. These physicians stood high in the medical profession as well as in public esteem, and testified that their charge was reasonable, and even less than what was usually allowed them as expert witnesses, and that the amounts of their claims had been agreed upon beforehand. There was no evidence to the contrary. The trial judge held that the amount of their fee was wholly within the discretion of the trial court and that the allowance was reasonable. But the Supreme Court, in its wisdom, held that these experts were entitled to the full amount of their bills, which was the value of their services, and that the evidence showed that this value was at least equal to the amount claimed, in consequence of which, it amended the judgment appealed from, by increasing it to \$229.85 in favor of each physician, the Parish of Lincoln to pay all costs.

There is an Illinois case, wherein a physician, subpoenaed as an ordinary witness in a personal injury case, declined to answer an hypothetical question for the reasons that "an expert witness is entitled to a different and greater compensation than an ordinary witness is allowed, and an expert is not required to give expert testimony without compensation as an expert, unless a reasonable compensation shall have been paid or provided for."

The trial judge fined the physician for contempt of court, which sentence was appealed to the Appellate Court and that court in a long and verbose decision confirmed the decision of the lower court, that physicians must answer questions and give expert testimony even though they were or are subpoenaed as ordinary witnesses and not paid fees commensurate to the value of their services. This was the first time that this question had ever been directly decided by an appellate court in Illinois, and when I

called the attention of some of my medical confrères to it, it caused not a little adverse discussion. Manifestly, the principle that our knowledge—the product of our laborious study and research—is our property, and is as a matter of fact all that we have to sell, is trampled upon by this decision. We have been taught to believe that no one, be he individual, corporation, court, or state, has a lawful right to take away from us that which is our property, without rendering back to us due and just compensation, so, naturally, it irks us to learn that what we have a right to consider our property may be taken from us, and that without proper remuneration. So far as we have been able to learn, we can do little or nothing about it, except in rare instances. I have been able once, so far, to circumvent this decision, and will be glad to explain to members of the Radiological Society how it may be done, if they care to write me.

The witness fees which a party pays to expert witnesses cannot be recovered from the adverse party in the suit, but must be borne by him, irrespective of the final outcome of the trial.

GENERAL POINTS TO BE OBSERVED BY EXPERT WITNESSES

Some general points to be observed by medical expert witnesses who are not accustomed to appearing in court are as follows:

It is usually advisable not to make too prompt a reply to the questions asked. Perhaps one of the lawyers wants to make an objection to your answering. This is particularly true during cross-examination.

It is usually advisable to stop when the question asked has been answered, and it is seldom advisable to volunteer information. If more information is desired, further questions will be asked.

It is *never* advisable to undertake to

answer any question which you do not thoroughly and clearly understand. Ask to have the question repeated rather than do that.

Do not fear the lawyers. Remember that you know much more about medicine than they do and *they know that you know that*. Many of them try to give out the impression that they know a lot about medicine—and other things—but it is almost always a “bluff.”

The following amusing incident occurred a few years ago. I had been called as an expert witness to give an opinion as to whether or not a fracture was shown in certain roentgenograms of the cranium, introduced as evidence. The examining attorney on the opposite side of the case was a dapper, conceited young fellow, who seemed to be nettled at my positive, sure-of-myself manner of answering the questions, and in cross-examination evidently determined to catch me, and discredit my testimony, which he manifestly considered was damaging his case. He repeatedly and in various ways asked me about my qualifications, particularly in relation to my knowledge of anatomy, and finally asked me if I could give him the location of some obscure ganglion—naming it. My prompt reply that “It is between the parietal bone and the os calcis” completely satisfied him. A medical friend of mine, who happened to be present, stuffed his handkerchief into his mouth and hurriedly left the court room.

Do not be ashamed or afraid to say that you do not know. No man is expected to know all there is to medicine any more than any one man is expected to know all there is to law, biology, astronomy or any other subject.

Do not become confused, agitated, or excited by the attempted intimidation or interruptions of the attorneys. It is frequently their purpose to try to confuse or excite witnesses by repeated interruptions, so as to

cause them to contradict their previous statements or misstate something.

Do not be an advocate for the side for which you appear. Do not appear to favor either side. Your place is to tell the truth as you see it and *that only*, and not to try to influence the court or jury to any greater extent than that truth will or should. It is the lawyer's business to argue the case and not the business of witnesses to do anything except give testimony. Do not be controversial.

Do not be too technical in your answers to questions. Use the same sort of language that you would to ten-year-old children, because there may be jurors listening to you whose mentality is that of a ten-year-old. Use words that are in general use and as far as possible refrain from the use of technical terms.

As a rule, it is not advisable to become facetious. Jokes may be misunderstood and at best they tend to lower the dignity of the procedure, and cause one to lose caste, particularly with ignorant persons.

Speak slowly, and show that you mean what you say. Be convincing. Give out the impression that you are sure of yourself and unafraid.

If you are asked if you expect to be paid for your services, do not hesitate to say “yes” (if you do), and if asked the amount do not be at all backward in naming it (if it has been agreed upon). No sensible person expects you to donate your time, experience, and knowledge except to a deserving charity, and you need not be ashamed to place a high value on your services. The lawyers do this for their services.

Observation of these few points, and the maintenance of the usual presence of mind and calmness, such as you are wont to display in your daily routine of practice, are all that are necessary to make an excellent witness of any physician.

The physicians then appealed to the Police Jury to show cause why they should not be allowed the amounts they claimed in full. These physicians stood high in the medical profession as well as in public esteem, and testified that their charge was reasonable, and even less than what was usually allowed them as expert witnesses, and that the amounts of their claims had been agreed upon beforehand. There was no evidence to the contrary. The trial judge held that the amount of their fee was wholly within the discretion of the trial court and that the allowance was reasonable. But the Supreme Court, in its wisdom, held that these experts were entitled to the full amount of their bills, which was the value of their services, and that the evidence showed that this value was at least equal to the amount claimed, in consequence of which, it amended the judgment appealed from, by increasing it to \$229.85 in favor of each physician, the Parish of Lincoln to pay all costs.

There is an Illinois case, wherein a physician, subpoenaed as an ordinary witness in a personal injury case, declined to answer an hypothetical question for the reasons that "an expert witness is entitled to a different and greater compensation than an ordinary witness is allowed, and an expert is not required to give expert testimony without compensation as an expert, unless a reasonable compensation shall have been paid or provided for."

The trial judge fined the physician for contempt of court, which sentence was appealed to the Appellate Court and that court in a long and verbose decision confirmed the decision of the lower court, that physicians must answer questions and give expert testimony even though they were or are subpoenaed as ordinary witnesses and not paid fees commensurate to the value of their services. This was the first time that this question had ever been directly decided by an appellate court in Illinois, and when I

called the attention of some of my medical confrères to it, it caused not a little adverse discussion. Manifestly, the principle that our knowledge—the product of our laborious study and research—is our property, and is as a matter of fact all that we have to sell, is trampled upon by this decision. We have been taught to believe that no one, be he individual, corporation, court, or state, has a lawful right to take away from us that which is our property, without rendering back to us due and just compensation, so, naturally, it irks us to learn that what we have a right to consider our property may be taken from us, and that without proper remuneration. So far as we have been able to learn, we can do little or nothing about it, except in rare instances. I have been able once, so far, to circumvent this decision, and will be glad to explain to members of the Radiological Society how it may be done, if they care to write me.

The witness fees which a party pays to expert witnesses cannot be recovered from the adverse party in the suit, but must be borne by him, irrespective of the final outcome of the trial.

GENERAL POINTS TO BE OBSERVED BY EXPERT WITNESSES

Some general points to be observed by medical expert witnesses who are not accustomed to appearing in court are as follows:

It is usually advisable not to make too prompt a reply to the questions asked. Perhaps one of the lawyers wants to make an objection to your answering. This is particularly true during cross-examination.

It is usually advisable to stop when the question asked has been answered, and it is seldom advisable to volunteer information. If more information is desired, further questions will be asked.

It is *never* advisable to undertake to

Supreme Court of Georgia, which affirmed the judgment in the physician's favor.

Apparently, the principal error of the trial court urged on behalf of the patient was the following instruction to the jury:

"Unless you are reasonably satisfied from the evidence that the defendant failed to exercise reasonable and ordinary care, skill, and diligence in the *treatment* of the plaintiff's broken leg and foot, you cannot find for the plaintiff."

This instruction, argued the patient, would excuse the physician from negligence in diagnosis. In common parlance, said the Supreme Court, and often in the law, "treatment" is the broad term covering all the steps taken to effect a cure of the injury or disease. It includes examination and diagnosis as well as the application of remedies. The patient's complaint, it is true, spoke of diagnosis and treatment as distinct. The sense in which terms are used in a charge to the jury need not necessarily conform to the sense in which they are employed in the pleadings; they may become misleading in a given case and call for an explanatory charge. But the giving of this instruction is to be justified on broader grounds. While both counts of the complaint charge negligence in "diagnosis" as a proximate cause of the injury, the only causal connection between such negligence, if any, and the injury was improper treatment, or failure to apply the right treatment because of such bad diagnosis. Neither bad diagnosis nor want of diagnosis alone was sufficient. If the proper treatment was applied, no injury would result no matter what the diagnosis. If the proper treatment was not applied, because either of negligence in diagnosis or of other want of ordinary care, skill, or diligence, that treatment would be "negligent," using "treatment" in the limited sense of the complaint. Negligence in "treatment," either in the inclusive or limited sense, was essential to the plaintiff's recovery of damages.

shown by a roentgenogram that is not produced in court. The contention that the roentgenogram is a part of the hospital records and cannot be taken from the hospital presents no adequate excuse for a failure to produce it. There is no rule of law that places hospital records in a privileged class. They can be produced in court the same as the records of a corporation or any other records, corporate or private, that may be necessary to further justice between litigants. The roentgenogram should be produced in evidence so that the other party to the case may use it for the purpose of cross-examination and submit it to his own medical experts for examination, to enable them to testify as to their interpretation if they disagree with the expert who interpreted it on behalf of the party relying on it. A medical expert may not testify as to the cause of a person's physical condition or injuries, when his testimony is based in part on a report made to him by another physician or on information that he derived from private conversations with a third party.

Testimony of Expert Witnesses Appointed by Court (Vey vs. State (Ohio), 172 N.E.R. 434).—A mandatory provision of a statute that "the judge of the trial court shall appoint one or more disinterested qualified physicians . . . to testify as experts" does not make it mandatory that the experts so appointed be called to testify at the trial. The intention of the legislature in passing such a statute was to make expert testimony neutral and disinterested and to remove the evil often arising because of partisan expert testimony. Under the statute the appointment of experts is unquestionably mandatory, but the actual calling of the experts to testify is discretionary with the court. It often happens that court-appointed experts have formed no opinion. In such a case there would be no purpose in calling the experts merely to testify to that fact.

Expert Opinion on Roentgenogram Not in Evidence (Lefebvre vs. Western Coal and Mining Co. (Kan.), 289 P.R. 456).—A physician may not testify concerning what was

Fracture of Vertebra by Chiropractor (Witt vs. Reed (Okla.), 289 P.R. 291).—Reed, suffering from an "ordinary cold in his head," employed Witt, a chiropractor, to treat him. Reed alleged that he was injured by the

REPORTS OF CASES INVOLVING RADIOLOGICAL MATTERS¹

Myeloma Attributed to Trauma (Loveless vs. Red Top Cab Co. (Wash.), 291 P.R. 344).

—Loveless was injured by a taxicab operated by the defendant company. He instituted suit for damages but died before the case was tried. His wife, as administratrix, was substituted as plaintiff. The trial court gave judgment in her favor, which judgment was affirmed by the Supreme Court of Washington.

Prior to the accident, Loveless was in good health. The injuries complained of were received Aug. 6, 1928. Loveless, while crossing the street, was struck by a taxicab, the front fender hitting him in the lower part of the back. He fell on the fender and then to the street. He was taken to a hospital, where he remained for two or three days. He continued under the care of a physician, however, for three or four months. About three weeks after the accident, his health began to fail. About a month after the accident, pain developed in the lower part of his back. This became more acute as time went on and was attributed by his physicians to arthritis of the spine. About the middle of December a roentgenogram showed a slight mottling or coloring in the lower spine. From the time when his health began to fail, three weeks after the accident, his condition grew gradually worse, and for three or four months prior to his death he was confined to his room and most of the time to his bed. April 13, 1929, he developed pneumonia. He died three days later. An autopsy showed a myeloma in the lower part of the spine.

A physician testifying for the plaintiff stated unequivocally that in his opinion the myeloma was caused by the accident. Another physician, also testifying for the plaintiff, felt confident that the injury at the very least predisposed to the development of the myeloma and was a factor in its causation. Physicians called by the defendant testified that the myeloma was not caused by the accident. Taking

into consideration the history of the case, said the Supreme Court, together with the evidence of the two physicians who testified for the plaintiff, there was substantial evidence to take to the jury the question whether the myeloma was or was not caused by the accident.

Physicians called by the plaintiff testified that the primary cause of death was the myeloma and that the pneumonia was the terminal cause. Physicians called by the defendant testified that the pneumonia was the primary and proximate cause of death. From what was disclosed by the autopsy, it was apparent that death was rapidly approaching even if pneumonia had not appeared. Whether death was caused proximately by the myeloma or by the pneumonia was a question of fact to be determined by the jury. Where the original act is wrongful and would naturally in the ordinary course of events produce death, as the jury had a right to find in this case, the occurrence of pneumonia as the terminal cause does not relieve the defendant from liability.

Diagnosis as Part of Treatment (Hester vs. Ford (Ala.), 130 So.R. 203).—The plaintiff, Hester, injured his ankle. No X-ray machine was available, and the plaintiff refused to take an anesthetic. The defendant physician therefore administered morphine and examined the injury by sight and touch. He found a fracture of the tibia at the joint, set it and applied splints. Several weeks later a roentgen examination showed that the fibula was fractured some two or more inches above the joint and that the fragments overlapped. An operation was necessary. Thereafter the plaintiff sued the defendant for malpractice. One of the counts of the plaintiff's complaint charged that the defendant negligently failed to use in and about "said diagnosis and treatment" of the plaintiff's injury reasonable care, skill, or diligence. Another count charged that the defendant failed to use in and about "said diagnosis" of plaintiff's ankle such care, skill, or diligence as was reasonably necessary to ascertain the character of the injury. Judgment was rendered in favor of the defendant physician. The patient appealed to the

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Jessner was convicted of murder, after court-appointed experts had testified concerning his sanity. He appealed to the Supreme Court of Wisconsin, alleging that the statute under which those experts had been appointed had deprived him of various constitutional rights. The statute, he complained, undertakes to authorize such an observation, examination and investigation of the accused as constitute an invasion of his right of privacy, guaranteed by constitutional prohibitions against unreasonable search and against compulsory self-incrimination.

If the statute under consideration, said the court, attempts any violation of the constitutional rights of an accused person, it must be through that provision that authorizes his commitment to a hospital for observation. It does not follow, however, that, because a fact pertains to or is connected with the person of one who is accused of crime, that fact is necessarily a secret; personal characteristics which are commonly open to and observable by all persons are not of that secret nature which the constitutional prohibitions here discussed are designed to protect. This statute should not be construed, if it is possible to construe it otherwise, as a legislative attempt to compel an accused person to submit to an unconstitutional inspection or investigation. It is construed here, said the Supreme Court, as authorizing the court-appointed experts to make only such investigations and examinations as are consistent with the constitutional rights of the accused, but no attempt will be made at this time to set the limits of such rights. In the present case, said the court, no matter what the constitutional rights of an accused person may be, there is no contention that they were violated. The appointment of experts by the court and their examination of the defendant were by and with the consent of the defendant. Their testimony, therefore, cannot be said to be based on knowledge obtained as the result of any violation of the constitutional rights of the accused.

The defendant contended further that the statute authorizing the appointment of expert witnesses by the courts violates that provision of the Wisconsin constitution that guarantees

a jury trial, since the witnesses appointed by the court must be identified to the jury as court-appointed experts. This, he contended, makes the court stand sponsor for the credibility and reliability of such experts. The "jury" guaranteed to the defendant by the Wisconsin constitution, however, the court said, is such a jury as was known by the common law in the courts in the territory of Wisconsin before the state was organized. The only limitation which the common law imposed on the trial judge in the matter of expressing his opinion with reference to the merits of a case was that he should make it clear to the jury that they were not bound by that opinion and that their decision on the facts rested exclusively with them. Whether the sponsoring of any witnesses by the court is good public policy, however, is no longer a matter of judicial opinion: the dominant opinion of the Wisconsin legislature on the subject has received expression in this statute, and such an expression on matters of public policy prevails unless it contravenes some constitutional provision. There is no constitutional provision in Wisconsin relating to jury trials which prohibits the practice prescribed by the legislature in this statute.

The conviction of the defendant was affirmed.

Liability of Third Person for Medical Fees (Swarens vs. Pfnisel (Mo.), 26 S.W.R. (2d) 951).—Pfnisel was burned in a gasoline explosion in the course of his employment. His cousin, Mrs. Amel, with whom he boarded, requested Dr. Swarens to render medical services and promised to pay his bill. Pfnisel was unconscious when Swarens first visited him and at no time said anything to Swarens about employing him. Swarens, however, did not charge Mrs. Amel on his books for his services; he made the charge to Pfnisel. He rendered no bill to Mrs. Amel, but when his services ended, he, at Mrs. Amel's request, delivered his bill, made out against Pfnisel, to Pfnisel's attorney, who was negotiating for a settlement with the insurance company by which Pfnisel's employer was insured. Swarens' bill was not paid, so he sued Pfnisel

treatment. He, therefore, sued the chiropractor and obtained judgment. From this judgment the chiropractor appealed to the Supreme Court of Oklahoma, where the judgment was affirmed.

Reed alleged, among other things, that the chiropractor, in disregard of the ordinary skill used by ordinarily skilful practitioners of chiropractic, negligently and unskilfully failed properly to diagnose his physical condition and unskilfully and negligently applied a greater amount of force to his, Reed's, body than was reasonably necessary under the circumstances, thereby permanently injuring him. Describing one particular treatment, Reed alleged that the chiropractor requested him to sit upright on a small bench, placed his knee against Reed's back, and, after bracing himself, reached his arm around Reed's head and gave the head a quick jerk. Immediately, Reed, the patient, suffered a sharp pain in the region of the fourth cervical vertebra. This continued to grow in intensity and severity until the evening of the following day. Then the pain became so severe that a physician was called. Reed continued to grow worse, becoming delirious and almost totally paralyzed. The second, third, fourth, and fifth cervical vertebrae, Reed claimed, had been injured and dislocated and he himself permanently injured. A roentgenologist testified that roentgenograms taken by him showed almost complete destruction of the spinous process of the fourth cervical vertebra, a fracture through the body of the fifth cervical vertebra, and a callus on part of the upper surface of the sixth thoracic [sic] vertebra. The trial court instructed the jury that before it could decide for the patient it must find that the chiropractor failed to use such ordinary care and skill as were used by his school of practice and that such want of ordinary skill and care was the proximate cause of the patient's injury. The jury was further instructed that if the chiropractor bestowed on the patient such reasonable and ordinary care as a physician in the same line of practice would ordinarily have bestowed in such a case, then the patient could not recover and the verdict must be for the chiropractor. In these instructions the Su-

preme Court found no error. The jury, concluded the court, evidently found from the evidence that the chiropractor did not use such ordinary care and skill in his treatment of the patient as were used by practitioners of the same character.

*Admissibility of Hospital Records (Sullivan vs. Morse (Mass.), 171 N.E.R. 668; Calhoun vs. Morse (Mass.), 171 N.E.R. 668; Connors vs. Morse (Mass.), 171 N.E.R. 668).—*The general rule is that if a document, such as a hospital record, is offered in evidence and found admissible in part, the entire document should be admitted. The same rule prevails where a document not strictly admissible is admitted in evidence by agreement. Irrelevant matters, however, although a part of an otherwise admissible conversation set forth in the document, should be excluded, notwithstanding the general rule that the entire document or record should be admitted.

*Care and Skill Correlated (Rothschild vs. Barck (Mo.), 26 S.W.R. (2d) 760).—*The physician owed the plaintiff a duty to exercise ordinary care and skill. His failure to exercise either would be negligence. If he was incompetent and attempted an operation which he knew he could not perform, it would be negligence. So the term "negligence" covers not only a lack of care but also failure to exercise skill which the person possesses and the attempt to exercise skill which he knows he does not possess.

*Appointment of Expert Witnesses by the Court (Jessner vs. State (Wis.), 231 N.W.R. 634).—*In Wisconsin, in any criminal case, whenever expert opinion evidence is necessary or desirable the trial judge may appoint one or more disinterested qualified expert witnesses (Wis. Stats., sec. 357.12). The fact that such expert witnesses have been appointed by the court must be made known to the jury, and the witnesses are subject to cross-examination by both parties. The court may commit an accused person to an asylum for observation by all interested experts.

spine of the plaintiff. The roentgen-ray machine that he used, he said, was "not in very good working order"; it was an old machine and had seen its best days. He did not use a fluoroscope. The roentgenograms were, however, he testified, a correct representation of the plaintiff's cervical spine. The appellant, defendant in the court below, contended that under the circumstances stated the roentgenograms were not competent evidence. In the

absence of other convincing proof tending to establish accuracy, said the Supreme Court of Illinois, it would certainly be improper to admit roentgenograms shown to have been taken on a machine not in "good working condition," but no absolute rule has been laid down making roentgenograms taken on such a machine inadmissible regardless of other testimony and considerations. In the present case, the evidence was properly admitted.

PREDICTS HUMAN LIFE WILL BE NO LONGER BUT HEALTHIER

The span of human life, the actual number of years which an individual may attain, will probably not be lengthened much beyond its present limit; yet the sixty years of the present span of life will be lived in much greater health and happiness, it has been predicted by a speaker before the American Philosophical Society.

Man is a reasoning animal, however, the speaker pointed out, and his future will not be merely the struggle for existence. His adapta-

tion to his environment and his conquest of that environment thus far make it impossible to predict that he will not go farther along those lines and push ahead the extent of his life span. . . . Further application of present scientific knowledge will make the average man's life not only longer, but healthier. Unnecessary disease must disappear. Death must no longer come in childhood. Debilitating, incapacitating illness must be postponed. Each of us should have the hope of growing old gracefully, in the possession of his mental and physical powers.—*Science Service*.

and Mrs. Amel jointly. Judgment was rendered against both of them, but Mrs. Amel appealed, ultimately carrying the case to the Supreme Court of Missouri, Division No. 2.

Mrs. Amel contended that her promise to pay Swarens for his services was void, because it was not in writing, since the statute of frauds provides that "no action shall be brought to charge . . . any person upon any special promise to answer for the debt, default or miscarriage of another person" unless the agreement is in writing. Her contention, said the Supreme Court, was well taken, citing *Price vs. Chicago, M. & St. P. Rd. Co., 40 Mo. App. 189*, to show that if the beneficiary under a promise is liable at all, the promisor not being solely liable, the promise comes within the statute. Ordinarily, said the court, the question as to whom credit was given is one for the jury. The fact that Swarens' charges on his books were against Pfnisel alone, and not against Mrs. Amel, might not be controlling as a matter of law. The fact, however, that he sued both Pfnisel and Mrs. Amel, alleging that he had rendered services at the instance and request of both of them and prayed judgment against both shows beyond any question that credit was given to some extent at least to Pfnisel. In view of his conduct, Swarens cannot say that credit was extended Mrs. Amel alone. The fact that Swarens presented a bill made out to Pfnisel to Pfnisel's attorney tended further to prove that credit was extended in part at least to Pfnisel. The court held, therefore, that the promise made by Mrs. Amel came within the statute of frauds and was void because it was not in writing. The judgment of the court below, against Mrs. Amel, was reversed.

Sarcoma of a Bone Attributed to Trauma (Halper vs. The Golden Rule (Minn.), 231 N.W.R. 195).—Minnie Halper, a clerk in the Golden Rule Department Store, Oct 23, 1928, was carrying a box weighing 44 pounds. It fell and struck her on the inner side of her leg, "just below the point of the knee." The blow left a red mark, which turned blue and black. Her leg pained her for a few days, and then apparently it seemed normal. A few weeks

later the leg pained her again and began to swell at the place of the injury. December 29, she complained of the pain, to the nurse in the hospital or rest room at her place of employment, whom she had occasion to consult about another ailment. She did not associate it, however, at that time, with the injury she had suffered, nor did she do so until after the physician whom she first consulted, February 2, questioned her. Roentgenograms taken after that consultation showed that the bone was affected. An incision was made, February 10, and material was removed for microscopic examination. One pathologist thought that the examination disclosed a sarcoma; the other thought that it did not. Another examination, March 13, resulted in a definite diagnosis of sarcoma. The leg was amputated, April 17, three inches above the knee. The industrial commission awarded compensation for the loss of the leg. The employer and its insurance carrier brought the case by writ of certiorari to the Supreme Court of Minnesota.

The medical witnesses agreed, said the Supreme Court, that no one knows positively what causes sarcoma, or whether it may result from trauma. One physician testified that in a majority of sarcoma cases there had been a previous, comparatively trivial injury, the effects of which passed away, only to be followed by a sarcoma. Another testified that a large percentage of patients having sarcomas give histories of previous trauma. Both believed that the sarcoma in the present case resulted from the injury. The sarcoma developed in the exact point of the injury, and there was nothing to indicate any other cause. In the opinion of the Supreme Court, the evidence justified the industrial commission in inferring that the sarcoma resulted from the injury. The order of the commission was therefore affirmed.

Admissibility of Roentgenograms Taken on Antiquated Machine (Garvey vs. Chicago Rys. Co. (Ill.), 171 N.E.R. 271).—A physician, specializing in radiology, testified that he personally took and developed the roentgenograms, concerning which he testified, of the cervical

sis, or compression from one side, or a circular constriction. The picture in these cases was one of marked narrowing of the bowel lumen, with distortion and angulation; between the narrowed portions there were localized dilatations. The mucosa was continuous throughout the entire area, but there were bizarre deformities of the mucosal outline in the tortuous portions. Due to the marked stenosis, it was sometimes difficult to secure good visualization of the mucous membrane relief. Further study of ovarian carcinomas revealed several facts.

(1) It is difficult and often impossible to determine by examination which ovary is involved, since either may be displaced.

(2) Distant metastases are infrequent, extension usually being by implantation.

(3) In the true pelvis evidence of compression of the bowel develops early, since the structures are so limited by the surrounding bone.

Without doubt a number of processes other than ovarian carcinoma may produce similar stenotic lesions of the bowel. In women, however, a thorough gynecologic examination should be made if such a condition be found. In describing this condition it is well to call it a stenosis of the bowel with intact mucosa, rather than a benign stenosis.

HISTOLOGIC CHANGES IN AN IRRADIATED DOUBLE CARCINOMA OF THE UTERUS

DR. WINDHOLZ: A 37-year-old woman was subjected to intensive irradiation therapy because of vaginal bleeding apparently caused by a fibroid. The last treatment series had been given eight months previously. As a consequence of prolonged bleeding a total hysterectomy was performed two months after the last irradiation. Study of the operative specimen revealed in the anterior wall of the corpus uteri a coarse-grained, greenish-white tumor,

the size of a plum, which was not circumscribed. Histologically it showed the structure of a double carcinoma, composed of both squamous and cylindrical epithelium. In the interstitial structures of the tumor and in the myometrium there were numerous miliary epithelioid cell tubercles. In portions of the tumor which had an identical biologic environment and were subjected to the same irradiation factors, the squamous epithelium showed extensive degenerative changes; whereas, in the cylindrical epithelium little change could be found. In the midst of the degenerative squamous epithelium were seen well nourished, apparently newly developed strands of cylindrical epithelium, with many mitoses. In the region of the degenerating squamous epithelium there was predominately a giant cell and leukocytic mesenchymal reaction, while about the cylindrical epithelium the reaction was chiefly of plasma cells and polymorphonuclear leukocytes. The author feels that there is a qualitative and quantitative difference in the reaction of the two cell types to irradiation and a different growth potential.

DISCUSSION

DR. BORAK explained that a curettage had not been performed because of the patient's relative youth. The possibility of carcinoma had, therefore, not been seriously considered.

DR. R. PAPE stated that it was quite possible that the two types of tissue were not of the same age, since the one might have appeared earlier than the other. If this were true, both cell types were not subjected to the same biologic and radiotherapeutic factors as the author had suggested. He called attention to the fact that squamous-cell carcinoma of the portio uteri reacts favorably to radiation therapy in contrast to adenocarcinoma of the corpus, in which poor results are obtained.

PROCEEDINGS OF WIENER GESELLSCHAFT FÜR RÖNTGENKUNDE

FEB. 3, 1931

AN AUTOMATIC REVERSING MILLIAMPERE METER FOR LIMITED EXPOSURES

DR. SPIEGLER: Most diagnostic roentgen examinations at the present are those in which fluoroscopy and radiography are combined. In changing from fluoroscopy to radiography and *vice versa* the measuring range of the milliamperere meter must be changed. If this is not possible, there are two alternatives; either the scale must be set for high milliamperage reading or for low. If the instrument be set for high reading, it is most difficult to secure accurate readings on low milliamperages, and in this event the fluoroscopist may unwittingly use a much higher current than he wishes to use. On the other hand, if the instrument be set for low reading, there is great danger that it will be injured by higher current. Because of lack of time the change in measuring scope is often not made, and consequently injury to either the apparatus or the operator may result. If the change could be made by the operator without shifting his position, although the disadvantage of time lost would be overcome, there would still remain the objection that very careful attention be paid to the instrument. All these disadvantages are overcome by an instrument which the author demonstrated. It is an automatic milliamperere meter, so constructed that for small currents the small scale and for large currents the large scale is automatically used. For fluoroscopy and therapy the small scale is always used, but if a radiograph is to be made the large scale is automatically used, and, in addition, this is made known by a signal light. The change from fluoroscopy to radiography can be rapidly executed without any necessity for the operator to direct his attention to the apparatus. Any

of the existent milliamperere meters can be built into such an automatic apparatus by inserting a relay connection into the existent shunts; this also supplies current for the illumination of the dial.

DISCUSSION

PROF. HOLZKNECHT: The simple and refined solution of the technical problem I regard as Columbus did the egg. I had not dared to submit this problem to a technician for I felt that it could not be solved. I have always felt the great need for such an automatic arrangement.

DR. FLEISCHNER discussed what he felt to be a technical disadvantage of this apparatus.

SIX CASES OF OVARIAN CARCINOMA COMPLICATED BY STENOSIS OF THE SIGMOID

DR. POHL: Of the six cases, four were proved at autopsy, one at operation; the other case is still under treatment. These cases were observed in the course of a year at Prof. Haudek's Institute. It is worthy of note that in the same period of time a similar change, due to another condition (metastasis from carcinoma of the cecum), was found in only one case. The symptoms of each of the author's patients were almost exclusively referable to the intestinal tract. More than half had been diagnosed as large bowel carcinoma, peritonitis, etc. In three cases it was possible to exclude by roentgen examination a primary intestinal process. There were perisigmoidal changes producing a narrow lumen; an adnexal tumor was, therefore, thought to be the cause and its presence was proven by autopsy. The stenoses had the following characteristics: The stricture involved either the rectosigmoid flexure or a large portion of the sigmoid. Usually the stenosis is rather long, the narrowing marked. There was not the simple narrowing of the usual type of steno-

CASE REPORTS AND NEW DEVICES

A CASE OF ANEURYSM OF THE ABDOMINAL AORTA

By C C McCLURE, M D, Cleveland Clinic
CLEVELAND, OHIO

Since cases of abdominal aneurysm in which the symptoms are suggestive of renal stone are rather infrequently encountered, and also because the aneurysm is rarely found to have penetrated through the diaphragm, it is believed that the following case history will be of interest.

A man, 46 years of age, entered the Clinic complaining of "kidney trouble" and back-ache. The symptoms had been noticed, first, nine months previously, at which time he experienced pain in the kidney region of the left side and back, radiating downward

to the flank, the distress persisting for several days. He had frequency but there was no hematuria. The pain had subsided after the patient's physician had given him a dose of medicine and he apparently remained well until five days before he entered the Clinic, when another attack occurred; since then, the pain had been severe and constant. Relief could be obtained only by standing and leaning to the left side. The patient had lost fifteen pounds in weight.

The personal history revealed nothing of significance, and upon physical examination no gastro-intestinal symptoms were found to be present. There were no significant findings in the urologic examination, except for signs which led to the suspicion of an



Fig 1 In this roentgenogram the arrow points to the aneurysm which has penetrated from the abdominal cavity into the pleural cavity



Fig 2 Roentgenogram showing the aneurysm considerably increased in size and extending higher. This roentgenogram was made several months after that shown in Figure 1

DR. WINDHOLZ: In photomicrographs which had been exhibited both squamous and cylindrical epithelium could be demonstrated in the same alveolus of the cancer; they were separated only by the thickness of

a cell membrane. The author felt that this was conclusive proof of the identical age of the two tissue structures. Hence, both must have come under the same environmental influences.

ELECTRIC SEPARATION CARRIES ELECTRONS THROUGH AIR SPACE

Electrolysis, or electric separation of the elements in a chemical solution, is carried on in a new way by a process invented by Prof. Alfons Klemenc, of the University of Vienna. The method promises results of great importance in research, and possibly also in industry.

In ordinary electrical separations, both positive and negative electrodes are immersed in the solution to be treated, and each takes out

the atoms or atom-groups that are attracted to it. In Prof. Klemenc's process, the negative electrode is suspended above the surface of the liquid, and separated from it by an air space. When the current is turned on, a stream of electrons is given off by the electrode into the air.

The electrical phenomena that accompany this kind of electrolysis are quite different from those of ordinary electrolysis, Prof. Klemenc states. Electrolytic reduction is carried on more easily, and electrolytic oxidation proceeds much more intensely.—*Science Service*.

the aneurysm ruptured into the left pleural cavity. Diagnosis of aneurysm was made at autopsy and the diaphragm was found to be ruptured. This case was apparently one of a "rupture through the diaphragm" and not an "erosion through the diaphragm," as in the case reported here.

The diagnosis of abdominal aneurysm is often difficult, is frequently not made before operation, and often only at autopsy.

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CROLY, H. G., and GRAVES, W. R.: Abdominal Aneurysm which Ruptured through the Diaphragm. Trans. Royal Acad. Med., Ireland, 1894-95, XIII, 389-391.

TECHNICAL POINTS FOR ROENTGENOLOGISTS

By CARLOS HEUSER, M.D.

BUENOS AIRES, ARGENTINA

Translation by N. G. GONZALEZ, M.D.

Centralization of the Tube Over the Body.—It is difficult to so adjust the tube over the body as to make a film of the lung



Fig. 1. Before taking the radiograph, the clothespin is placed on the nose and the patient is ordered to close his mouth during inspiration or expiration, according to whether the radiograph is desired on the former or the latter.



Fig. 2. To take a radiograph of the esophagus during the act of swallowing, the patient is placed on the table, with a glass beside him containing an opaque meal. He then draws up the contents of the glass by placing a tube or pipette against his teeth and sucking up and swallowing the contents. Several radiographs are taken during this process.

or any other part, particularly when one wishes to repeat a film previously made, either for the purpose of making a second radiograph or to locate the duodenum when fluoroscopy is not done. This inconvenience is solved by placing in the filter support a piece of cardboard 2 mm. thick, in the center of which a hole about 3 mm. in diameter has been made. This hole must be in the center of the circumference of the rays projector and in the tube support of the tube producing the rays. The cardboard is placed in the aluminum plate holder used for radiotherapy. Placed in this position, the filament is then lighted. It is observed that two shadows are projected, the largest of which is the light reflected from the anticathode, and the other is the light from the filament. One of these lights always serves as a guide. When a radiograph is to be made, the filament is lighted. Notice



Fig 3 Roentgenogram showing marked erosion of the bodies of the lower dorsal and upper lumbar vertebrae.

aneurysm of the left renal artery. There was no shortness of breath, no palpitation, no edema. The pulse rate was 120 and the blood pressure 150/100. A general examination of the chest showed nothing of significance and no masses could be palpated in the abdomen.

A diagnosis was made of left kidney stone, neoplasm of the left kidney, arteriosclerosis and hypertension, and the patient was advised to enter the hospital.

A roentgenographic examination of the abdomen by means of pneumoperitoneum disclosed a large abdominal aneurysm.

On February 11, 1929, under spinal anesthesia, a left oblique lumbar incision was made and the left kidney exposed. No evidence of a tumor or a stone was found, but the lower pole of the kidney was soft. The kidney was removed. Just above the kidney area and beneath it, a pulsating mass could be seen from which dark blood flowed after a needle was inserted. This mass was

believed to be an aneurysm of the abdominal aorta originating just below the diaphragm. As it was not possible to institute surgical treatment for this condition, the wound was closed. The patient made an uneventful recovery.

On November 11, 1930, the patient returned to the Clinic complaining of pain in the left lumbar area from which he had suffered for several months. There was marked restriction of movement in the upper lumbar area. Roentgenographic examination showed the bodies of the first lumbar and the eleventh and twelfth dorsal vertebrae to be about half destroyed by the aneurysm. Marked right scoliosis was noted.

On December 12, 1930, a roentgenographic examination of the gastro-intestinal tract showed no evidence of a pathologic condition either in the stomach or colon. Upon fluoroscopic examination it was found that the large, pulsating mass had extended through the left side of the diaphragm. During respiration the diaphragm was seen to slide up and down the mass; during deep inspiration the mass seen in the lower left pneumonic field appeared to be much larger than during expiration. Figure 1 shows the level at which the tumor penetrated the diaphragm. The pneumoperitoneal films are not available, having been destroyed in the Clinic fire in May, 1929; however, they showed that the tumor was well below the diaphragm, and the evidence was confirmed at operation.

The patient was advised to take as good care of himself as possible and when last heard from he was working.

Aneurysm of the abdominal aorta is of comparatively uncommon occurrence. The symptoms frequently resemble those of lumbago, intestinal or kidney trouble, or malignancy. In 1895, Croly and Graves, of Dublin, reported a case in which the symptoms were referable to the left kidney and

case that the surgeon had suspected a myeloma on clinical grounds.

Cases such as these must have occurred in the practice of every radiologist, and point to the moral that, in countries where the radiologist usually confines himself to radiology, his opinion is only one of the spokes (though usually a valuable one) in the wheel of diagnosis of a case, and it is salutary for him to realize that, no matter how carefully his work has been performed, his findings may not always be confirmed at operation or by other means.

DIVERTICULUM OF THE DUODENUM

CASE REPORT

By JOSEPH H. LUCINIAN, M.D., MIAMI, FLORIDA

Diverticula of the gastro-intestinal tract are not rare: cases have been reported of diverticula in the esophagus, stomach, duodenum, jejunum, ileum, and the large intestine. They may be single or multiple, and are less frequent in the upper tract than in the lower. The following case is reported not only because of the unusual size of the duodenal diverticulum, but also because of the difficulty of differential diagnosis.

REPORT OF CASE

J. I. B., a married, white woman, aged 40, was referred to me on July 26, 1930, by Dr. W. A. Haggard, for roentgen examination of the gall bladder and gastro-intestinal tract. Her past history revealed nothing significant, except for influenza and pneumonia, and an appendectomy fifteen years previously. There had been no loss of weight. The marital history was irrelevant; no pregnancies. The present history dates back two to three years, at which time the patient began having distress after taking acid fruits



Fig 1. Film made in the prone position, showing a large duodenal diverticulum, apparently connected with the bulb and pylorus. Normal ascending duodenum lateral to diverticular sac.

and such foods as pickles and tomatoes. Pain would commence as soon as food was swallowed, gradually diminishing in severity and finally disappearing in two or three hours. However, immediately on taking more food, pain would return. Milk had no influence on the pain, but soda and milk of magnesia at times would relieve it completely for a short period. There was no pain at night. Rarely the patient vomited. At one time there had been bile in the vomitus, but never blood or coffee-ground material. Two months previously, the patient had eaten turnip greens for supper, and the next morning vomited the whole in an undigested state. At times there was a burning sensation in the epigastrium to the right of the midline, but chiefly after taking acid foods. Occasionally, pain would strike in

where the light falls upon the body and mark the spot with a pencil. By so doing, duplicate radiographs can be made. This method is easy and practical. Experience will tell the radiologist if the shadow should be higher or lower, a matter of adjusting the tube.

Respiratory Immobility.—It is difficult to make some patients hold their breath, or to get radiographs of them either during expiration or inspiration: they always do the opposite to what they are told.

The method here described gives me good results. The spring is taken out of a clothespin and replaced by paste, because the metal is strong and produces pain. When one desires to make a radiograph of the lung or gall bladder, and it is essential that the patient shall not breathe, the clothespin is placed on his nose so that he may not breathe through his nostrils, and he is ordered to breathe through his mouth. When one wishes him to stop breathing, he is ordered to close his mouth. If a film is to be taken after inspiration, the patient is asked to take a deep breath and then close his mouth. The same method is employed for expiration. Thus the patient is not able to breathe or move the diaphragm because the nose is closed—that is usually what spoils a radiograph.

Impregnation of the Stomach Wall.—In my book printed in 1918, as well as in the *Semana Medica*, I have published the prescription for an opaque meal which is as follows: Barium sulphate, 60-90 grams; gum arabic, 5-10 grams; sugar, 15-20 grams; boiled eggs (whole), 2; milk, 200 cubic centimeters. By mixing these ingredients and shaking them, there is produced a good opaque meal, emulsified by the eggs, gum, and milk. The first dose is composed of two tablespoonfuls of this meal and 30 c.c. of sodium bicarbonate solution, and the second dose of twice this amount. The gas from the water becomes volatile, containing

anhydrous carbonic gas, on account of the warmth of the body, and makes the barium sulphate adhere to the stomach wall, by which means, I am able to obtain good radiographs.

X-RAY "DIAGNOSIS"

By R. W. A. SALMOND, M.D.
LONDON, ENGLAND

Every now and again a radiologist is impressed by the fact that his findings are not confirmed at operation, and is puzzled because the opinion he offered seemed quite straightforward. What is even more disconcerting is the feeling that he would be justified in expressing a similar opinion on a future case presenting similar appearances. An explanation is hard to give unless one falls back on the adage that radiology is an inexact science, or accepts the inevitable, taking comfort in the fact that mistakes become less frequent as experience increases.

Recently a stomach which had had a gastro-enterostomy done four years previously was examined by one radiologist and no sign of any stoma was observed. A few months later the writer independently made the same observation, that there was no evidence of any stoma acting. As the patient had some obstructive symptoms operation was performed, and the surgeon reported that the stoma was quite patent and he could pass two fingers through it. There was also no sign of any ulcer in its neighborhood to cause spasm.

Another example was a dental case which showed on the film all the appearances of an abscess or granuloma (not the mental foramen) at the apex of one of the lower canines, with the surrounding alveolus showing a normal appearance. The tooth was extracted but no abscess was found. As there was a granulating mass on the gum immediately posterior to the canine, a piece of this was also removed and found to be a myeloma. One ought to say in the latter

the duodenum." Often a systematic search of this area will amply reward the roentgenologist for his efforts, by revealing to him the true cause of many indefinite symptoms.

Differential Diagnosis.—Enlarged or dilated loops of the duodenum should not be confused with a true diverticulum. The former will usually show peristalsis and a serrated outline, normal in this part of the intestine, which is absent or indistinguishable in diverticula. Reversed or retrograde peristalsis may be seen. Diverticula of the stomach are less frequent, but should be borne in mind. A large, accessory pocket of an ulcer, either of the stomach or duodenum, usually has a smooth outline and occasionally the barium is capped in it by a bubble of gas. Perforated gastric ulcer may produce a sac of varying size, the barium entering through the perforation and simulating a diverticulum. Less frequently, dense, visible gallstones may be confused with a diverticulum. Needless to say, loops of the duodenum may be distinguished by the *valvulae conniventes*, which are absent in diverticula.

Traction diverticula are commonest near the pylorus, are usually secondary to ulcers, and are composed of all three layers of the intestinal wall. In the pulsion type the wall is made up of the mucous layer only. These are more common near the duodeno-jejunal juncture and the papilla of Vater.

Diverticulitis or peridiverticulitis may supervene, in which case nausea, vomiting, local tenderness, and increased pain characterize the complication.

SUMMARY

1. A case of an unusually large duodenal diverticulum is presented, offering difficulty in clinical and roentgenologic diagnosis.
2. The symptoms consisted of a slight and indefinite epigastric discomfort and pain



Fig. 2. Film made in the standing position, showing failure of the diverticulum to fill with barium.

following the taking of acid food, of two to three years' duration.

3. A history of chronic digestive disturbance or vague and unexplained digestive symptoms of long standing should arouse our suspicion and should be thoroughly investigated for duodenal diverticulum.

4. It is the common practice in many large institutions to do fluoroscopy in the vertical position only. More recently many internists have been induced to install fluoroscopes, practically all of the vertical type, with which to make cursory examinations of the stomach and duodenum.

5. The diverticulum in the case herewith presented eluded all efforts at visualization in the standing position, but was readily visualized in the horizontal position.

6. Unless a combined vertical and horizontal fluoroscopic examination is carried

the region of the right scapula. There was no history of gallstone colic. The patient's appetite was poor; she was never constipated; her habits were regular. There was no history of blood or mucus in the stools.

On physical examination the patient was found to be well nourished and well developed. On fluoroscopic examination both lungs were seen to be well aerated; the heart, thoracic vessels, the diaphragm, and the posterior mediastinum showed nothing remarkable. The esophagus was smooth and showed no delay. The stomach was of the modified fish-hook type, hypertonic, showing active peristalsis and hypermotility. It was completely empty in about two hours. The pylorus and duodenal bulb were smooth and regular. There was no tenderness on deep palpation, either in the stomach or the duodenum, but in the space just above the pylorus and lateral to the duodenal bulb, there was exquisite tenderness.

The patient was next examined in the supine position and the area under suspicion explored fluoroscopically, with negative findings. She was then placed prone in the right oblique position, with the head of the table lowered. Immediately a large pouch was seen just above the pylorus. The stomach emptied so rapidly that it was impossible to distinguish this sac from the bulb, the third portion of the duodenum, or the pyloric end. This large sac closely simulated a dilated loop of the duodenum, but close observation showed that just behind it, the opaque meal was emptying rapidly through another loop into the jejunum. The next point to be considered was whether the sac was connected to the cap or the pylorus. By turning the patient in various directions, it was proved to my satisfaction that the sac had no connection with either, but had a direct connection by a narrow stalk with the ascending portion of the duodenum, proximal to the ligament of Treitz. Now that the sac was filled, the patient was turned on her

back and the area of tenderness was found to correspond exactly with the anomalous sac. She was again placed in the erect position and an attempt made to visualize the pouch. It was emptied and the barium could not be forced into it by manual effort. The duodenum and the sac were completely empty at the same time as the stomach. In the horizontal position it was again demonstrated beautifully. In its transverse diameter it was about two and one-half centimeters wide and in the longitudinal, about three centimeters long. The remainder of the gastro-intestinal tract showed no evidence of diverticula. The gall bladder was slow in emptying. A roentgen diagnosis of large duodenal diverticulum was made.

The patient was operated on four days later. The sac was located with some difficulty, posterior to the stomach. Resection was time-consuming and difficult, because of numerous adhesions. The gall bladder was palpated and no stones felt. The patient did not recover from the operative shock, and died in fifteen hours.

COMMENT

Several interesting features stand out in connection with this case, which should prove instructive. The history of epigastric pain, referred to the right shoulder, was suggestive of gall-bladder disease, with probable gallstone formation. The pain coming on immediately after the taking of acid foods was suggestive of gastric, rather than duodenal, ulcer. In a previous paper (1) I emphasized the fact that duodenal diverticula may simulate gastric, duodenal, or gall-bladder disease. Frequently the symptoms and signs are obscure rather than clear-cut and definite. It is in this type of history that we should be on the lookout for such unusual lesions. It is well said that the critical area of the abdomen is situated where "the head of the pancreas lies in the arms of

sternum; the pulse was regular; the blood pressure was 126/80; the upper border of the liver was at the level of the fourth rib anteriorly; the lower border reached 7 cm. below the costal margin in the mid-clavicular line; the spleen was enlarged and extended 7 cm. below the costal margin. There was an old healed scar over the left tibia, and a definite limitation of motion of the left hip in all directions.

Laboratory Findings.—Urine, specific gravity 1.025; albumin, negative; sugar, negative; urobilin, trace. Blood: red blood corpuscles 3,140,000; white blood corpuscles 4,500; hemoglobin, 70 per cent; neutrophils, 63 per cent; lymphocytes, 35 per cent; Wassermann reaction, negative.

At the time of admission a survey was made of the entire skeleton and it was noted that the cortex of all the bones was thin, this being particularly true of the bones of the vault. In addition, a pathologic condition was seen to involve several of the long bones. This change was most extensive in the femora. It began at the level of the lesser trochanter and extended downward to the condyles. The lower thirds of the femoral shafts were expanded. The cortex appeared to be eroded from the inside in the upper portion, while in the lower third the lamella of the bone seemed to be infiltrated and separated, in addition to the erosion. The lower third of the right femur was the seat of a healed fracture.

The head of the left femur was mottled and almost suggested fragmentation. The left tibia, the seat of the osteomyelitis at 15, was bowed inwards and showed some loss of density of the medulla. Several small areas of lessened density were seen in the upper end of the right humerus and one small punched-out area was seen in the upper end of the right radius.

On the basis of the physical examination and the roentgenologic appearance of the bones a diagnosis of Gaucher's anemia was

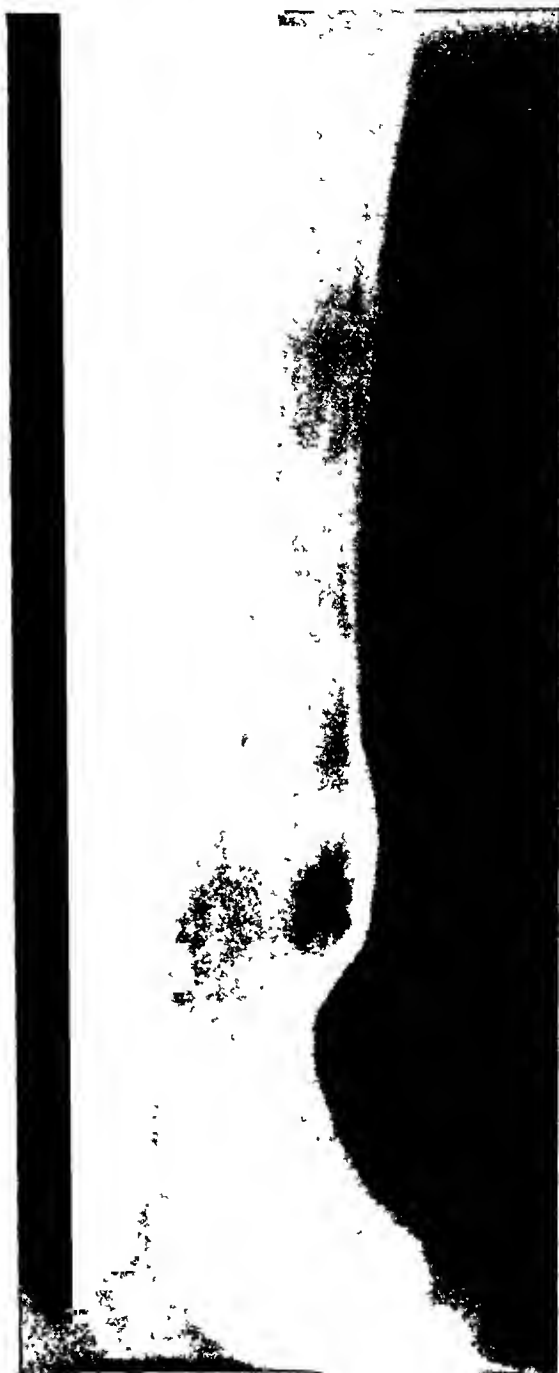


Fig 3 Right femur, lateral view, showing the area of destruction in the region of the fracture.

made. The patient refused permission for a biopsy.

On the basis of the result obtained by Sosman (1) with radiation, the spleen and long bones were radiated, with the follow-

out, it can readily be seen that not a few of these obscure cases will remain undiagnosed.

REFERENCE

- (1) LUCINIAN, JOSEPH H.: Diverticulum of the Duodenum Perforated into the Pancreas. *Am. Jour. Roentgenol. and Rad. Ther.*, December, 1930, XXIV, 684, 685.

A PROBABLE CASE OF GAUCHER'S ANEMIA

CASE REPORT

By W. S. MUIR, B.A., M.B. (Tor.), and
L. R. LINGEMAN, M.D.

From the Out-patient and Radiological Departments
of the Rochester General Hospital
ROCHESTER, N. Y.

Chief Complaint.—Pain in the left hip region when stepping up or down.

Family History.—Irrelevant.

Past History.—Childhood uneventful. At 15 years of age the patient had an osteomyelitis of the left tibia, which was operated on and which healed promptly. She enjoyed good health until she was 22 years of age. At that time she fell downstairs, striking her right thigh, but was able to get

up and walk. A few days later, while lying on the beach, she turned quickly and fractured her right femur at the junction of the middle and lower thirds. At that time a diagnosis, on the basis of an X-ray examination, was made of a pathologic fracture due to osteitis fibrosa cystica. The fracture was treated in the usual manner and bony healing resulted. During the following winter the patient received some X-ray treatment over the region of the fracture. She enjoyed good health until February, 1930, when she began to complain of pain in the left hip joint region when going up and down stairs or when she remained seated in one position for any length of time. She entered the Out-patient Clinic in April, 1930.

Physical Examination.—At that time the patient appeared to be a well nourished, fairly well developed, Jewish female 25 years of age. Her skin was dark; head and neck were normal; the thyroid was not enlarged; a systolic murmur was heard in the aortic area and along the left border of the



Fig. 1. The femora, antero-posterior view. Note the erosion of the cortex from the inside.



Fig. 2. The right femur shows a healed fracture. Note the expansion of the lower portion of the diaphysis, and the infiltration.

EDITORIAL

LEON J. MENVILLE, M.D. . . . *Editor*
BUNDY ALLEN, M.D. . . . *Associate Editor*

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RADIATION THERAPY

Radiation therapy has become so tremendously important that it is now recognized by eminent medical authorities as an indispensable factor in the modern treatment of cancer. Its progress in recent years has been so rapid and effective that only a bold prophet would predict its future development. This has been the result, in no small degree, of the indefatigable workers in radiological research, who have standardized its application with almost mathematical accuracy, so that it has become a dependable and highly efficient form of treatment.

The American Association for Cancer Research and the American Society for the Control of Cancer have approved and recommended the use of radiation therapy in the treatment of cancer. In spite of these splendid endorsements and its universal use, there are some physicians and surgeons who would ignore its value.

A perusal of the current medical literature appertaining to the use of radiant energy in the treatment of precancerous and cancerous lesions reveals that some authors are somewhat reluctant to acknowledge the important position it occupies at the present time, when discussing the treatment of cancer. Their attitude in this regard can be construed to mean that, in their opinion, radiation therapy has been overrated and is fast becoming obsolescent. Or, we may be-

lieve that theirs is but another case of not being able to see the woods for the trees.

It is not difficult for an unprejudiced mind to ascertain from the literature the many notable accomplishments of radiation therapy in the treatment of malignancy. In order to thrive, plants need the stimulating influence of sunshine, and, in a like manner, physicians often need the stimulating influence of good literature if they are to progress and become successful in the practice of medicine. Those in search of the beneficial effect of medical knowledge will find in *RADIOLOGY* many interesting and educational articles on radiation therapy, and such literature will prove especially advantageous to those who manifest an indifferent attitude toward this form of treatment.

It is only necessary to cite a few of the many instructive articles on this subject which have appeared in the issues of *RADIOLOGY*, all of which will stand as substantial proof of the brilliant results obtained by radiation therapy. In the February issue of *RADIOLOGY*, which was dedicated to Dr. Joseph Colt Bloodgood, in recognition of his brilliant work on cancer, will be found numerous articles on the X-ray diagnosis of bone tumors and also an excellent editorial on "Working Rules for Lesions of Bone," by Dr. Charles F. Geschickter of the Garvan Research Laboratory, Johns Hopkins University and Hospital. This is but one example of the recognition of the value of the X-ray and radium in the diagnosis and treatment of cancer by eminent authorities who are not radiologists. While this splendid contribution is largely diagnostic, very important information may be obtained in regard to radiation therapy. The interesting editorial on "Imposition on Radiation

ing factors: K.V. 190; ma. 20; filters 0.5 mm. Cu and 2 mm. Al; distance 50 centimeters. The individual treatments were as follows:

5-21-30. Spleen (posterior), 12 minutes.

5-23-30. Spleen (anterior), 12 minutes.

5-23-30. Femora (anterior), including hip joints, 12 minutes.

5-27-30. Tibiæ (anterior), 12 minutes.

5-28-30. Humeri (anterior), 12 minutes.

6-4-30. Spleen (lateral), 10 minutes.

6-13-30. Spleen (anterior and posterior), 8 minutes each.

6-17-30. Femora (anterior), including hip joints, 12 minutes.

7-17-30. Femora (posterior), including hip joints, 12 minutes.

7-17-30. Spleen (anterior), 6 minutes.

7-18-30. Tibiæ (anterior) and humeri (anterior), 12 minutes each.

The patient obtained some relief from the pain and limitation of motion in the left hip, but her hemoglobin dropped so low that radiation was discontinued. The spleen and liver did not decrease in size. The entire skeleton was re-surveyed six months after suspension of the treatment and no changes were noted in the bones.

Immediately after discovering high blood cholesterol the patient was restricted to a low fat diet. Subsequent observations showed a fall in blood cholesterol, but since cholesterol metabolism is complicated and the blood cholesterol normally undergoes marked variations, no estimate of the effect of low fat diet can be made without observation over a much longer period of time. Continuance of such dietary restrictions seems warranted, as Gaucher's disease, one

of the xanthomas, since the work of Panzer (3), 1906, and Pinkus and Rich (2), 1908, has been considered a manifestation of disturbed lipid metabolism.

During the course of observation the following laboratory work was recorded:

5-8-30. Gastric test meal, 1 oz. of stomach residue: free HCl 34 c.c. N/10 NaOH; total acidity 54 c.c. N/10 NaOH; no blood.

7-18-30. Cholesterol (plasma). 190 mg. per cent.

9-30-30. Basal metabolic rate 16 per cent blood sugar fasting, 114 mg. per cent. Cholesterol (whole blood), 290 mg. per cent; calcium (serum), 11 mg. per cent; phosphorus (serum), 3.8 mg. per cent.

11-20-30. Cholesterol (whole blood), 255 mg. per cent.

1-8-31. Cholesterol (plasma), 185 mg. per cent.

3-4-31. Cholesterol (whole blood), 190 mg. per cent.

4-28-31. Calcium content of urine, 0.06 gm. (expressed as calcium oxide) per 24-hour specimen.

5-20-31. Cholesterol (whole blood), 255 mg. per cent; serum calcium, 13 mg. per cent.

There has been little change in the patient's condition during this time. The general feeling of weakness and fatigue continues. She has experienced definite relief from the pain in her left hip and is able to sit for a greater length of time and change position with less discomfort. Neither the liver nor spleen has changed in size.

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- (2 and 3) Quoted by ROWLAND, R. S., *Arch. Int. Med.*, November, 1928, XLII, 611-674.



The New Jefferson Hotel, St. Louis, where the Seventeenth Annual Meeting of the Radiological Society of North America will meet November 30 to December 4, 1931.

tropolis, as well as the capital of commerce and industry in the Middle West, is privileged to be your host.

It was on the evening of February 14, 1764, that a little band of French pioneers first landed on the west bank of the Mississippi River, at what is now the foot of Walnut Street in St. Louis. For many days, patiently fighting the current, they had poled and dragged their heavy craft up the great river from Fort de Chartres, sixty miles below. Wearied by their labors, they slept that night on their boat.

Like the landing of the Pilgrim Fathers, the coming of this "First Thirty," as they became known in colonial days, proved a milestone which marked the beginning of an empire. For when, on the following morn-

ing, August Chouteau lead his men across the sandy beach and up the plateau overlooking the river, pointing out to them there a line of blazed trees, the ringing blows of axes soon sounded through the woods, and the building of St. Louis began. Then and there was born the spirit of a community.

The previous year a far-sighted engineer named Laclede had conceived the idea of a permanent settlement in some favorable river location. Searching for the ideal spot, he, accompanied by August Chouteau, explored the Mississippi north and south, and, as the still preserved record relates, "he fixed upon this place, marked with his own hands some trees, and said to Chouteau, 'You will come here as soon as navigation opens, and form a settlement after the plan

Therapy," by Douglas Quick, of New York City, which was published in the September, 1930, issue, is another example of the type of article appearing in RADIOLOGY. The numerous illuminating contributions on radiation therapy by Dr. Francis Carter Wood and Dr. George E. Pfahler deserve special commendation. Also, the splendid and enlightening articles on the same subject by Arthur W. Erskine, of Cedar Rapids, Iowa; Albert Soiland, of Los Angeles; Edwin C. Ernst, of St. Louis; Arthur U. Desjardins and Harry H. Bowing, of the Mayo Clinic; Dr. Edith H. Quimby and Dr. G. Failla, of the Memorial Hospital, New York City; Dr. L. S. Taylor, of the Bureau of Standards, Washington, D. C., and many others equally as prominent, are all outstanding accomplishments in this particular field of medicine.

In the successful treatment of any disease, it is imperative for the physician to have a thorough knowledge of its pathology. This information will be the guiding factor in the selection of the kind of treatment to be employed, a fact which is particularly true in cancer therapy, where the form of treatment will depend largely upon the type of malignancy. For instance, whether it is radiosensitive when X-ray or radium, or both, are used, or whether it is of a different type, will decide if the treatment is to be surgical, or if the best results are to be obtained by the combined use of X-rays, radium, and surgery.

We should exercise every precaution in choosing the correct form of treatment in cancer cases, and by no means should we permit ourselves to be prejudiced in favor of the specialty we practise and ignore that which experience has proven to be the one of probable benefit to the patient. It must not be forgotten that the physician's first duty is always to the patient, regardless of any pet notions he may have for or against any particular method of treatment.

There can be no denial of the fact that

certain cancer patients are treated by surgery who would have received greater benefit if radiation therapy had also been employed, and likewise, radiologists at times treat certain malignancies that could have been treated better surgically.

What is needed at the present time is a better understanding of the indications and limitations of the use of the X-ray, radium, and surgery in the treatment of cancer, and too much emphasis cannot be laid on the importance of a thorough knowledge of its pathology by the radiation therapist and surgeon.

This dissertation must not be construed as a defense of the use of radiation therapy, as it needs no defense, but only praise. Its purpose, however, is to make known the fact that there are practising physicians in these days of scientific medicine who show a disinclination to acknowledge the value of this agency. I want to press home to them the thought with all the earnestness of which I am capable, that radiation therapy and surgery have been instrumental in creating a spirit of optimism, which is the finest thought the human mind can cherish in regard to the treatment of cancer.

THE ANNUAL MEETING

ST. LOUIS, OL' MAN RIVER, AND THE SEVENTEENTH ANNUAL MEETING OF OUR SOCIETY

On November 30, 1931, the medical profession of St. Louis will welcome the Radiological Society of North America to spend a week on the banks of Ol' Man River, to enjoy the unbounded hospitality of the famous New Hotel Jefferson, and to visit and take advantage of the medical facilities of this miracle city, so rich and glorious in the romantic development of the history of medicine and surgery, as well as radiology.

The new St. Louis, a rich, modern me-

as far north as the Great Lakes. These the English tried in vain for many years to break.

Within five years the fur trade of St. Louis had grown to the amount of \$80,000 annually, a great sum in those days. That trade was the commercial cornerstone, the basis of prosperity. Every year thereafter saw the city's radius of influence lengthen. Up the Mississippi and Missouri crept a line of outposts. St. Louis became the gateway of the stream of migration, the starting point of expeditions in all directions. Some of these were military, establishing forts; some scientific, to explore and exploit; more were to establish communities, to open commercial avenues. The Lewis and Clark Expedition in 1804, opening the Northwest, was one of these. So, too, the Frenchmen of St. Louis paved the way for the American occupation of Louisiana. A branch of the Chouteaus started Kansas City; Robidoux, of St. Louis, established St. Joseph; one of the Menards founded Galveston. A hundred Western cities and towns owe their beginning to St. Louisans.

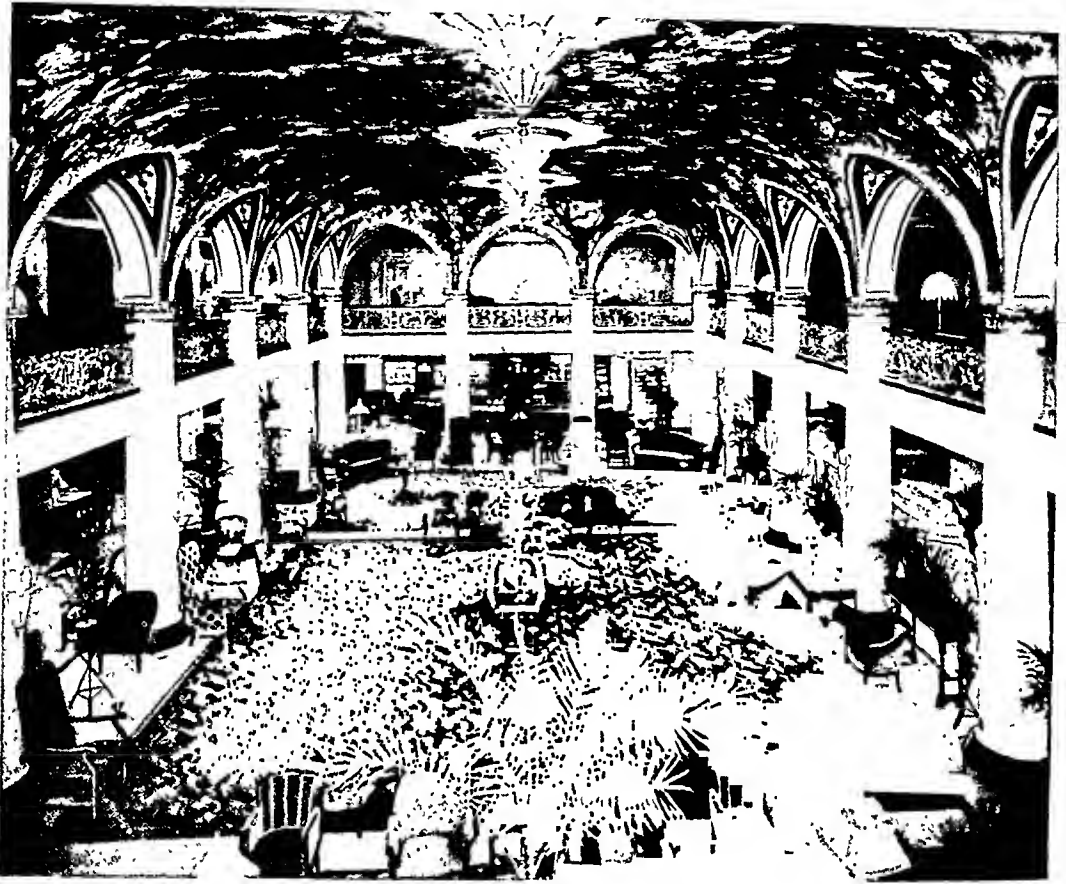
With the "Louisiana Purchase" in 1803, all that vast stretch of territory which is now the central and western part of this country came into national possession, more than doubling the area of the United States. Meanwhile, St. Louis has steadily grown. Seven years after its incorporation as a city in 1823, its population was 4,977, ranking forty-fourth among American cities. In 1833 it was in twentieth position and growing fast.

Missouri became a State in 1821, and, in time, became the central State of all the Union. Two States away, to the south, to-day lies the Gulf of Mexico; two States north is the Canadian line; five States east is the Atlantic; five States west, the Pacific. Thus, Missouri, and St. Louis, its chief city, is the geographical heart of the Union, the very center of its life and activities.

The year 1811 marked the appearance of the Mississippi steamboat. Five years later the first steamboat came up the river to St. Louis. For half a century thereafter the river trade grew by leaps and bounds. Just prior to the Civil War this river traffic was at its height. Hundreds of the old-time steamers, their decks piled high with cotton, daily ploughed the Mississippi. The steady, chugging beat of their paddles and the hoarse boom of their giant whistles awoke the echoes throughout the valley. Millions of dollars were invested in the river fleet. St. Louis was at that time the leading city in the West.

On the borderland between North and South, Missouri suffered cruelly from the Civil War, more than one-tenth its battles being fought upon Missouri soil. The great current of traffic, which up to that time had flowed north and south, was abruptly broken. The tides of trade turned east and west, served by rails instead of rivers. During the reconstruction period St. Louis temporarily lagged, yet it soon caught the cadence of the shriller whistles and moved on, losing but one rank in the procession of American cities. And to-day, the sixth largest manufacturing city, St. Louis, with its nineteen trunk lines operating thirty lines of railroad, has become America's second greatest railroad center, with a reborn river traffic greater than was ever dreamed possible, and with developing possibilities which only the most farsighted can conceive.

St. Louis has many unique advantages not afforded other cities. Situated as it is, it is the most easily accessible city in the United States. The Terminal Railroad Association of St. Louis has the largest unified freight and passenger terminals in the world. It owns and operates the great St. Louis Union Station by which all passenger trains enter and leave the city. It has more than 400 miles of track, handles 4,660,000 freight cars and 650,000 passenger cars an-



The Lobby, New Hotel Jefferson, St. Louis, where members of the Radiological Society of North America will gather during the week of November 30 to December 4, 1931.

which I shall give you. For here may well develop one of the finest cities in America, since here are such unusual advantages of location and of central geographical position!"

Those were indeed pioneer days, days when the European powers, England, France, and Spain, contended for a continent. At that time neither cities nor towns existed in all the silent wilderness of the Mississippi Valley. Here and there, hundreds of miles apart, roughly stockaded and scantily garrisoned forts constituted the only outposts of civilization, the sole refuge against Indian attacks. Frontier lines there

were none. Life in the New World was a continual struggle for existence.

Other expeditions, French and Spanish, soon sought to overshadow the little settlement of St. Louis. A Spanish fort was built a short distance to the north. Yet so well had Laclede chosen, and so energetically had his followers labored, that these competitive efforts gradually merged with St. Louis itself. Within three years its colonists, by sheer force of spirit, had established valuable fur-trading monopolies with the twenty-eight principal Indian nations, including not only those west of the Mississippi, but also those east of the river and even

ELMORE CALLAWAY THRASH, M.D.

Elmore C. Thrash, M.D., of Atlanta, Georgia, a prominent internist with a strong leaning toward radiology, died suddenly on June 22, 1931.

Dr. Thrash was born at Gay, Georgia, February 20, 1867, and attended Gordon Institute at Barnesville, Georgia, after which he taught school for a few years. He was graduated from the School of Medicine of the University of Louisville in 1891. After serving an internship at Louisville City Hospital, he entered practice in his native town. After a few years he moved to Atlanta, where he continued in active practice until his death.

He was keenly interested in medical politics and served his fellow-physicians in numerous capacities in local, state, and national medical organizations, where his presence and counsel were always felt for the public and professional good. For the last five years he was a delegate to the American Medical Association from Georgia, last year being appointed on the Committee on Publications and the Committee on Medical History. Other medical offices held were Counsellor for the Medical Association of Georgia, Past-president of the Chattahoochee Valley Medical and Surgical Association, Fulton County Medical Society, Medical Association of Georgia (1921-1922).

He had been Professor of Pathology and Bacteriology at the Atlanta School of Medicine, 1905-1914; Professor of Diseases of the Chest, 1914-1917, and was on the staffs of Grady, Piedmont, St. Joseph's, and Georgia Baptist Hospitals.

He was a member of Phi Chi, the Southern Medical Association, the Chattahoochee Valley Medical Society, the Fulton County Medical Society, the Medical Association of Georgia, the Radiological Society of North America, a Fellow of the American Medical Association and of the American College of Physicians. The various Masonic bodies

and the Mystic Shrine knew him as a frequent and active worker. He was a devout member of the Ponce de Leon Baptist Church of Atlanta.

Medicine has lost an earnest and conscientious advocate of the suppression of quackery, imposture, and ignorance, as well as a cultured, progressive, and sane advisor, in the passing of this highly respected Southern physician.

I. S. TROSTLER, M.D.

COMMUNICATIONS

THE PARIS CONGRESS

The Third International Congress of Radiology has passed into history. To describe in detail a chronicle of events during that week would be a task even for the finished columnist, so the writer will essay only a few personal glimpses, as memory may serve.

In the first place the expected hot weather of a Paris in July was graciously absent; in fact, the climatic conditions were ideal. The arrangements for the scientific and commercial program were as nearly perfect as conditions would permit, the Sorbonne serving admirably as a general center for everything except the exhibits, which were at a considerable distance but well worth any time or energy one could accord them.

It becomes necessary to dwell a little upon the social program which was executed upon such a scale as to make one gasp in astonishment. Luncheons, dinners, banquets, receptions, and soirées were upon a scale of splendor and lavishness that would challenge the thoughts of a world-wide financial crisis. This elaborate entertainment program was tendered by the French to their foreign visitors with an open-hearted generosity quite touching in its sincerity.

Irrespective of how much visitors appreciate and enjoy such splendid festivities, it

nually, serving 1,500 industries direct from its own tracks. It operates six belt lines, 175 switching engines, and has interchange connections with 27 railroads at more than fifty different points, thus utilizing the combined car supply of all these sources and insuring St. Louis shippers a maximum of facilities at all times.

Because the Mississippi River has played such a significant part in the history of our city, it is perhaps one of the first things that the visitor wishes to see. With its tugs and steamboats, its barges and tows, its pleasure craft, its ferry boats and mighty bridges, all flanked by the elevated railroad and the skyscrapers of the nearby business district, it presents an unforgettable picture. The old section of St. Louis adjacent to the river, still interesting, forms the district referred to by Charles Dickens in his "American Notes" as the "French Quarter."

St. Louis is at the center of the Mississippi River inland waterways system, the largest inland waterways in the world. This river system consists of a series of navigable rivers and canals having a total of 13,394.42 miles, which is more than any single railroad system in this country.

The Mississippi River system connects by water 29 of the principal industrial cities of 20 States in the Mississippi Valley, with a total population of 11,000,000, and affects by joint river and rail rates a population of more than 50,000,000.

Not all of these facts are pertinent interest to radiologists, yet, since all radiologists are citizens and many of them men of affairs, the facts here set forth are sure to be of interest to certain of our readers. It is well for all to know the importance of the city to which we will be going as guests during the week of the Annual Meeting.

IMPORTANT RAILROAD INFORMATION

ONLY 100 CERTIFICATES NECESSARY

The Chairman of the Central Passenger

Association on September 9, 1931, wrote as follows:

"We have pleasure in advising that Central Passenger Association carriers have reduced the minimum number of certificates required under the Certificate Plan regulations from 150 to 100, that is, if there is a total of 100 authorized certificates presented at your meeting, they will be validated by the Railway Special Agent.

"No change has been made in the last date on which validated certificates *must* be presented to ticket agents for purchase of return tickets at one-half fare, namely, December 8, 1931.

"Tickets so purchased, however, will be good for return passage to reach original starting point *within 30 days* in addition to date of sale of going ticket—*via* same route as used on the going journey."

This is a definite gain *in time* for the trip to our St. Louis meeting, besides a reduction in number of certificates necessary to secure the reduced rate.

I. S. TROSTLER, M.D.,
Manager of Transportation.

IN MEMORIAM

VICTOR W. MAXWELL, M.D.

The death of Dr. Victor Wiley Maxwell, at Gulfport, Mississippi, on June 26, 1931, was a shock to his many friends in both Mississippi and Louisiana. Dr. Maxwell was forty years of age. He was graduated from the Tulane School of Medicine in 1915. After a few years of general practice, he specialized in radiology, opening an office at Jackson, Mississippi, where he successfully practised his chosen specialty. His ability, his personality, and his professional attainments make his death a real loss to the Radiological Society of North America, to the community in which he practised, and to the friends who deplore his passing.

ical bodies in the United States to hold the Fourth International Congress in this country. Switzerland, Germany, and Italy presented similar invitations. The votes of the delegates awarded the Congress to Switzerland, with United States as second choice. Professor Schinz, of Zurich, was unanimously elected President. The majority of the delegates expressed their preference for the United States, but stated frankly that they had not the means with which to make the journey to America in 1934. One thing was firmly established at the Congress—the friendship of the scientific world for the United States of America.

ALBERT SOILAND, M.D.

Representative of the American Medical Association and Chairman of Delegation from the United States.

PRESENTATION OF THE GAVEL
FROM THE AMERICAN RADIOLOGICAL SOCIETIES TO
THE INTERNATIONAL
CONGRESS ON RADIOLOGY

PARIS, JULY 27, 1931

MR. PRESIDENT:

I am commissioned to bring to you greetings from the radiological societies of America, namely, the American Roentgen Ray Society, the Radiological Society of North America, the American Radium Society, the American College of Radiology, and the Radiological Section of the American Medical Association.

They have sent a gavel as an emblem of authority to you and your successors, as an expression of our spirit of co-operation.

This gavel has been made from ancient ivory that was buried in the glaciers of Alaska during the glacial period and is,

therefore, estimated by some to be about a million years old.

We hope that this gavel may pass from president to president during at least a hundred years, and serve as an emblem of peaceful authority at our international meetings.

GEORGE E. PFAHLER, M.D.

ANNOUNCEMENTS

THE SUBJECT INDEX

The Editor announces that he has in preparation a subject index covering all the original papers and abstracts published in RADIOLOGY since the first issue. This will, it is anticipated, be of material assistance to all readers of the Journal, and will fill a real need.

It is impossible to say just when the index will be issued, but the work is being pushed forward to the utmost.

MEMBERS OF THE SOCIETY HONORED

Lyell C. Kinney, M.D., of San Diego, California, and Orville N. Meland, M.D., of Los Angeles, have been appointed recently on the Cancer Commission of the California State Medical Society.

SCIENTIFIC EXHIBIT

There is still space available for those who desire to participate in the scientific exhibit for the Saint Louis meeting of the Radiological Society. All those planning to make application are urged to do so as soon as possible, since it is the desire of the committee to allot the space October 21.

P. F. TITTERINGTON, Chairman
Scientific Exhibits Committee.

is apparent that a reasonable limit to such entertainment must be established, or there is danger of the scientific aims and attainments of the world's congress assuming a secondary position. The writer ventures to suggest that in future congresses the major entertainment features be postponed until after the conclusion of the scientific program.

Now as to the business of the Congress. Representatives of twenty-six nations had signified their intention to attend—twenty-three actually answered roll call, with a total registration of over fifteen hundred delegates. This, under present conditions of financial stress, is a remarkable showing and demonstrates beyond the shadow of a doubt the importance of radiology to the scientific world. It was a distinct disappointment to all, including the French nation, that Germany responded with only five delegates. The one hundred or more German physicians, many of whom had entered valuable scientific contributions, were unable to leave Germany because, due to an official government edict arising from an acute financial crisis, they were unable to withdraw sufficient funds from their banks to cover their travelling expenses.

As already established by the Congress, the three official languages—English, French, and German—were in evidence, although a number of the Italian delegates presented subjects in their own tongue.

More than four hundred individual contributions had been accepted by the French officials with a time limit of ten minutes placed upon each essayist. This, in the writer's humble opinion, is not just, as an essayist who prepares something worthy of presentation before a world's congress should be allowed at least twenty minutes, and it would be far better to limit the number of contributions. While it is true that a great many of the subjects offered were well worthy of a world's congress,

there was some duplication of effort, due perhaps to lack of co-ordination between the central office in France and the attending nations. The American delegates were informed early by the French authorities that scientific contributions could be listed by radiologists at large directly with the Secretariat at Paris. This made it impossible for the American delegates to check over all the papers, and it is assumed that similar conditions existed in some of the other large nations. These remarks are not intended as a criticism for it is doubtful if any governmental body could have served twenty-three nations better, or as well, as our French colleagues, but merely to serve as constructive thoughts for future guidance.

While all the French delegates and officials were gracious hosts during the Congress, to that distinguished savant, our President, Dr. A. Bécère, all honor is due. He presided at all functions with a vigor and grace scarcely believable in a man of his years. He was ably assisted by his charming daughter, Miss Antoinette Bécère, and son, Dr. Claude Bécère. Also a word about the Secretary-General, Dr. René Ledoux-Lebard, a master in both the French and English languages, who was in constant demand by the non-French-speaking Americans and Englishmen. He fulfilled the post of an efficiency master. One outstanding event must not be omitted—the receptions by his Excellency M. Paul Doumer, the President of France, to the one hundred and fifteen official delegates at the Royal Palace. A gentleman well past middle age, suave, dignified, and forceful, he shook you by the hand, looked you in the eye, and you received your measure. He was "every inch a ruler," but proved a delightful, democratic host to the delegates.

THE 1934 CONGRESS

The American delegation presented a cordial invitation from the affiliated radiolog-

THE CHEST IN CHILDREN—ROENTGENOLOGICALLY CONSIDERED (Annals of Roentgenology, Vol. XII). By E. GORDON STOLOFF, M.D., Assistant in Pediatrics (Assistant Radiologist), Mt. Sinai Hospital; Adjunct Pediatrician, Beth Israel Hospital; Adjunct Pediatrician (Adjunct Radiologist), Sea View Hospital, New York. Foreword by BELA SCHICK, M.D., Pediatrician, Mt. Sinai Hospital, New York. Published by Paul B. Hoeber, Inc., New York, 1930. Pages, 432; illustrations, 406. Price, \$15.00.

In no phase of diagnostic roentgenology is an understanding of the clinical phenomena more essential to a proper interpretation of the roentgenographic changes than in diseases of the chest, and especially the child's chest. It is particularly fitting that Dr. Stoloff, who is an experienced pediatrician, equipped with a specialized knowledge of roentgenology as pertains to his specialty, should set forth his ideas concerning this subject. The continuous comparison of the clinical picture and course of a disease with the X-ray findings gives a valuable insight into pathologic physiology, and this knowl-

edge prevents many of the misleading and incorrect roentgenologic interpretations which are unfortunately often made by those whose judgment has not been tempered by the rebuffs of experience. It is the author's stated intention that in this work the roentgenology of the thorax in infancy and childhood shall be considered from the aspect of a clinician. Some radiologists may resent the trespassing of a clinician into their domain, but let them who would criticize reserve their judgment until after they have read this book.

Radiologists who have long desired an authentic text on the child's chest will be grateful for the information presented in this book. The subject-matter is concise and full of practical facts arranged in an orderly fashion that subsequent authors may well emulate. All progressive radiologists will enjoy and find much of value in this text. Students will find it indispensable, although for their use a more comprehensive consideration of the normal might have been in order.

The typography and illustrations are a credit to the high standard already created by the publisher.

BOOK REVIEWS

CUTANEOUS X-RAY AND RADIUM THERAPY. By HENRY H. HAZEN, M.D., Professor of Dermatology, Medical Department of Georgetown University; Professor of Dermatology, Medical Department of Howard University; member of American Dermatological Association, American Roentgen Ray Society. Published by The C. V. Mosby Company, St. Louis, Missouri, 1931. Cloth, 166 pages, with 28 illustrations. Price, \$3.00.

This short practical book outlines the theory and technic of the X-ray and radium treatment of diseases of the skin, gives advice about the actual procedures, and warns against the commonest pitfalls. It rather seems that the actual irradiation of dermatologic lesions (covered in 68 pages), a procedure requiring scrupulous care and meticulous attention to detail to ensure satisfactory results, is dealt with rather sketchily. The book is an excellent introduction to the more complete works on the same subjects, such as those of Andrews and MacKee.

IODIZED OILS AS AN AID TO THE DIAGNOSIS OF LESIONS OF THE SPINAL CORD AND A CONTRIBUTION TO THE KNOWLEDGE OF ADHESIVE CIRCUMSCRIBED MENINGITIS. By MARTIN ODIN and GOSTA RUNSTROM in co-operation with ADOLF LINDBLOM. Published by Kungl. Boktryckeriet, P. A. Norstedt & Söner, Stockholm, 1929. With 4 figures in the text and 38 figures on 6 plates.

Because their experiments showed the ordinary iodized oils to be highly irritating to the meninges and their subarachnoid injection associated with clinical and serological evidence of meningitis, the authors con-

ducted experiments to determine the irritating ingredient of the oils and to produce a non-irritating, iodized oil. These experiments employed sesame oil, almond oil, soya oil, olive oil, and linseed oil. After these oils were iodized it was found that sesame and soya oil produced the least amount of irritation. The authors prefer the iodized sesame oil because it is thinner, lighter in color, clearer, and can be produced with a higher yield. They have developed a method for producing the oil which has reduced the meningeal irritation to a minimum.

The reaction following the injection of the iodized oils produced by the authors was much less than that arising after the injection of lipiodol and similar substances. In none of the cases where their own oils were injected in quantities of 4.5 to 5 c.c. was there any rise of temperature, headache, stiffness of neck, or evident Lasègue. After injection of greater quantities, up to 10 c.c., one or a few of these symptoms arose but were just as often absent, and when present they were very slight and transitory.

The authors report their observations in a series of twenty-four cases as follows: Tumors, 3 cases; inflammatory changes, 14 cases; syringomyelia, 1 case; disseminated sclerosis, 2 cases; cerebral tumor, 1 case; trauma, 3 cases.

The intralumbar method of injection is preferred and the authors' technic differs in that they use large amounts of oil, usually about 10 cubic centimeters. Only by using this amount of oil can small tumors and defects be observed. The passage of oil up and down the spinal canal is observed in the supine and prone positions in order that the anterior and posterior subarachnoid spaces may be seen. The authors are especially interested in the diagnosis of localized inflammatory conditions, and most of their cases are of this group. It is hoped that this valuable work will be supplemented with observations on a larger series of cases.

ABSTRACTS OF CURRENT LITERATURE

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THE FOLLOWING ABTRACTORS HAVE CONTRIBUTED TO THIS ISSUE

J. N. Ané, M.D.
 L. J. Carter, M.D.
 F. Cavers, D.Sc., M.R.C.S.
 Charles H. DeWitt, M.D.
 M. J. Geyman, M.D.
 Otto Glasser, Ph.D.
 N. G. Gonzalez, M.D.
 H. W. Hefke, M.D.
 Paul C. Hodges, M.D.
 E. T. Leddy, M.D.
 Walter M. Levitt, M.B., M.R.C.P., D.M.R.E.
 W. D. Mackenzic, M.D.
 Roe J. Maier, M.D.

F. B. Mandeville, M.D.
 L. Marinelli
 H. C. Ochsner, M.D.
 Davis H. Pardoll, M.D.
 Willis S. Peck, M.D.
 Ernst A. Pohle, M.D., Ph.D.
 J. G. Stephens, M.D.
 C. G. Sutherland, M.B.(Tor).
 H. J. Ullmann, M.D.
 Jacob H. Vastine, M.D.
 W. W. Watkins, M.D.
 Lester J. Williams, M.D.
 V. Witting, M.D.

spectrum of the high speed electrons passing out of an aluminum window is presented. The high velocity limit corresponds to about 500 kilovolts when the transformer voltage is 600 kilovolts peak. The velocity spectrum appears to be continuous, and no absorption anomalies due to aluminum and lead foil are evident. The time required to obtain a velocity spectrum was reduced to a few minutes by allowing the electrons after being magnetically deflected, to pass through a copper foil into the air. The outside of the foil is coated with calcium tungstate, and the photographic plate is placed in contact with the tungstate. It is noted that part of the photographic action of the high speed electrons is due to fluorescence of the glass backing of the photographic plates.

authors observed that, after massive doses of X-ray, there was a rapid increase in the number of nuclei and a proportionate diminution in leukocyte count. After small doses there was an increase in the nuclei, which undoubtedly explains the increased resistance of the patient.

H. C. OCHSNER, M.D.

BLOOD CHANGES

Transmission of Blood Changes Produced by Irradiation. J. Gouin, A. Bienvenue, P. Daoulas, and Pérès. *Bull. Soc. Radiol. méd. France*, 1929, XVII, 286-288. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 248.

The injection of the blood of a healthy person in whom a leukocytosis had been produced by a roentgen irradiation into a second unirradiated healthy individual produces the same blood changes in the untreated individual. A syphilitic always reacts by hyperleukocytosis. This appears to be a specific reaction of the syphilitic to irradiation.

H. C. OCHSNER, M.D.

Nuclear Variations in Various Pathologic Conditions and after Roentgen Irradiation. T. Saragea and V. Valter. *Bull. Soc. méd. Hôp. Bucarest*, 1929, XI, 249-252. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 248.

The basis of the study was Lions' observation on the nuclei of leukocytes during the periods of remission of disease processes. He noted an increase in nuclei proportionate to the decrease of the total leukocyte count. The

Changes in Pigment following Irradiation. E. Kasatkin, A. Grubina, and S. Melbart. *Ter. Arch.*, VIII, 251-262; and *Deutsch. Zusammenfassung*, 1930, p. 262. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Dec. 12, 1930, IX, 581.

After irradiation of guinea pigs and humans with from 3.5 to 6 H.E.D., the authors have observed increased hemolysis and blood regeneration. The urobilin value was increased in the first three days after irradiation and remained the same for several days. If the number of reticulated cells increased, there was no diminution of hemoglobin or erythrocytes. The authors believe that the metabolic disturbances after irradiation are the sequence of increased hemolysis.

H. C. OCHSNER, M.D.

The Influence of Ultra-violet Irradiation on Blood Ferment. B. M. Koldajew and M. M. Altschuller. *Hoppe-Seyler's Ztschr.*, 1930, CLXXXVI, 223-228. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 252.

The authors studied the blood ferments after single and repeated irradiation. The serum lipase and the blood catalase are diminished after a single irradiation, the lipolytic action of the serum being increased. The degree of ferment changes is not entirely dependent upon the intensity of irradiation. Repeated irradiation produces a decrease of catalase and a decided increase of lipase, the latter being probably due to the general cell lipase content and the lymphocytes.

H. C. OCHSNER, M.D.

APPARATUS

Theoretical Aspects of Radiography
Warnford Moppett. *Med. Jour. Australia*,
May 2, 1931, I, 521-523.

An experimental X-ray tube is briefly described in which a metal plate served the double purpose of target and tube wall. It was possible to place a lead cover pierced by a pin-hole over the target and thus secure a point source of X-rays. This pin-hole screening could have been done, of course, without the use of the author's special tube, and a point source of X-rays obtained from any ordinary X-ray tube by the mere use of a pierced lead screen (Huyghen's principle).

The author does not state the intensity of the radiation thus obtainable, and the paper, therefore, loses much interest.

The general optical principles involved in the production of shadow pictures are discussed.

J. G. STEPHENS, M.D.

The Resolving Power Attainable in X-ray Spectroscopy by Photographic Methods.
Samuel K. Allison. *Phys. Rev.*, July 15, 1931, XXXVIII, 203-211. (Reprinted by permission.)

If w_c , the (half) range of glancing angle over which a crystal will reflect monochromatic X-rays, has been determined by the double spectrometer method, it is possible to calculate what resolving power is attainable from this crystal by photographic methods. Equations are set up giving the resolving power in terms of a , the slit width, and R , the distance from slit to photographic plate.

Some results are as follows: (1) No appreciable increase in resolving power is attainable by making $a/2R < \frac{1}{4}w_c$; (2) if $a/2R > 3w_c$, the resolving power does not involve w_c ; (3) the resolving power attainable in the first order is $1/2^{1/2}$ of that attainable in a double spectrometer with crystals of equal perfection. Equations are also derived by which observed line widths in photographic spectrometers may be corrected for slit and crystal dif-

fraction pattern effects. The results are applied to recent experimental results with photographic spectrometers, and it is shown that the width of $\text{MoK}\alpha_1$ observed photographically is considerably greater than the values obtained by the double spectrometer.

X-ray Absorption Coefficients of Mercury Vapor in the Region of its L-absorption Discontinuities. Fred M. Uber. *Phys. Rev.*, July 15, 1931, XXXVIII, 217-224. (Reprinted by permission.)

An apparatus is described which is suitable for absorption measurements up to two or more Ångströms. The absorber, which was in the form of superheated vapor the density of which could be calculated on the assumption of perfect gas behavior, was contained in an all-glass chamber. The windows were constructed of thin glass films in such a way as to withstand atmospheric pressure from either side. The mass absorption coefficients, μ/ρ , of mercury in the wave length region 0.74 to 1.4 Å. were determined by an ionization method. They were found to obey the relation $\mu/\rho = A\lambda^c$, where the constants A and c vary from branch to branch of the μ/ρ , λ curve. The value of c is 2.56 on the short and 2.66 on the long wave length side of the L-discontinuities. The magnitudes, δ , of the three L-absorption discontinuities, where δ is defined as the ratio of μ/ρ (the scattering coefficient being neglected) on the short and long wave length sides of an absorption limit, are $\delta L_I = 1.18$, $\delta L_{II} = 1.39$, $\delta L_{III} = 2.45$.

Five Hundred Kilovolt Cathode Rays.
R. E. Vollrath. *Phys. Rev.*, July 15, 1931, XXXVIII, 212-216. (Reprinted by permission.)

The high potential X-ray tube at the California Institute has been modified so as to permit either X-rays or cathode rays to be produced. Electron currents up to 35 microamperes have been obtained through an aluminum window. A typical magnetic velocity

the right. At 14 months there was a wider space between the nucleus of the head and the neck of the femur on the left than on the right. The neck of the femur was thicker and it was directed upward. At three and one-quarter years after the first observation, the left leg was shortened 3.5 centimeters. On the right, the epiphyseal line was horizontal, and the neck was directed upward. On the left, the epiphyseal line was vertical and there was a flaky rarefaction of the neck. At five years the epiphyseal line on the left was almost horizontal, but the trochanteric epiphysis was smaller on the left than on the right. Hoffa's conception that a vertical epiphyseal line is pathognomonic of congenital coxa vara is not borne out in these cases. The atrophy of the femoral head is due to disuse. There is usually a coxa valga on the opposite side. The cause of the condition is a disturbance of ossification.

H. C. OCHSNER, M.D.

Osteitis Fibrosa. H. Meyer-Borstel. *Bruns' Beitr.*, 1930, CXLVIII, 510-541. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 266.

The author observed 22 cases of osteitis fibrosa, 13 of which were the cystic type of Recklinghausen and 9 the deforming type of Paget. The localized, as well as the generalized type, can be traced to endocrine (thyroid, pituitary) disturbances. A transition from the monostic to the generalized form is possible. Medullary hematomas and traumatic medullary hemorrhage, rickets, and osteomalacia have been excluded as etiologic factors. Spontaneous healing is possible but infrequent. Local irradiation is ineffective, but endocrine irradiation may be of assistance.

H. C. OCHSNER, M.D.

Congenital Generalized Exostoses. Ion Tomesku. *Arch. orthop. Chir.*, 1930, XXVIII, 56-72. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 264.

In the upper and lower ends of the bones of

the extremities of a nine-year-old boy were found jagged, bony protuberances. There were also exostoses of the carpal bones, only the skull, the ribs, sternum, vertebrae, scapulae, and pelvis being free of them. Examination six years later disclosed no evidence of the exostoses previously observed.

H. C. OCHSNER, M.D.

Cleido-cranial Dystocia. K. Klinke and H. Pahlke. *Arch. Kinderheilk.*, 1930, XCI, 46-54. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Dec. 12, 1930, IX, 591.

This is a report of two cases in early childhood, with complete absence of both clavicles and failure of ossification of the fontanelles. There was no hereditary taint, and the mineral constituents of the serum were normal; therefore rickets and osteitis fibrosa could be excluded. There was no evidence of hypophyseal disturbance. The authors feel that this disease is due to a primary disturbance of ossification in the membranous bones analogous to osteogenesis imperfecta in cartilaginous bones.

H. C. OCHSNER, M.D.

About Silent Bone Infractures as the Cause of Diseases of Diaphyses and Epiphyses. Behr and Körner. *Röntgenpraxis*, July 1, 1931, III, 586-593.

During the War a disease called "trench-periostitis" of the diaphysis of the leg was discussed repeatedly. The authors have had the opportunity of seeing five similar cases in policemen. Clinically, the men had definite points of tenderness over the tibia. Roentgenologic examination showed either a circumscribed periosteal thickening, or infractures or fissures in that area. This picture may best be explained by small "undramatic" fractures, which led to no acute symptoms. The same holds true of the primarily not recognizable fractures of metatarsal bones, which become evident roentgenologically only after callus has been formed. It is possible that such

Studies on the Survival Length of Leukocytes *in Vitro*, Tested by Their Ameboid Movements. Junkichi Ono. Trans. Jap. Path. Soc., 1929, XIX, 172-179. Abstracted in Zentralbl. f. d. ges. Radiol., Sept. 19, 1930, IX, 247.

The ameboid movements of leukocytes in blood withdrawn from the ear of the guinea pig continued for twenty-one hours, the blood being kept at 40° centigrade. Exposure to sunlight or to roentgen or radium radiation produced a definite diminution of the motility time. The effect of sunlight and ultra-violet was greatest.

H. C. OCHSNER, M.D.

BONE (DIAGNOSIS)

A Case of Osteopoikilia. Ernst Haack. Röntgenpraxis, July 1, 1931, III, 611-613.

The osteopoikilia is a relatively rare structural anomaly of the bones. To the author's knowledge only fifteen cases have been reported. Roentgenological examination of a 26-year-old man showed multiple small areas of increased density in the bones around the knee and shoulder joints. The etiology of this anomaly is not clear and it is apparently of no clinical importance.

H. W. HEFKE, M.D.

Roentgenologic Studies on the Appearance of the Ossific Nuclei and the Growth of the Carpal and Tarsal Bones. S. Koyanagi. Nagasaki Igakkai Zassi, VIII, 261-275, and Deutsch. Zusammenfassung, 1930, pp. 275, 276. Abstracted in Zentralbl. f. d. ges. Radiol., Dec. 12, 1930, IX, 592.

The ossific nuclei grow more rapidly in the first six months of life, appearing earlier and developing more in female than in male children. In most of these nuclei, increase in width precedes that of height, the growth of the right and left sides being equal. The appearance and growth of the nuclei parallel the increase of body length and weight.

H. C. OCHSNER, M.D.

Fracture of the Base of the Olecranon, with Anterior Luxation of the Bones of the Forearm. G. A. Oddone. Prensa Med. Argentina, June 10, 1931, XVIII, 55-57.

This type of fracture is infrequent. Bruns reports 1.2 per cent in 3,650, and Plagemman 2 per cent in 371 fractures of the elbow. There are three types of fractures: (1) Those of the vertex; (2) those of the middle, and (3) those of the base. The author explains the last class in detail, and presents a case of this type, reduced under fluoroscopy with good results.

N. G. GONZALEZ, M.D.

BONE DISEASES (DIAGNOSIS)

Lesions of the Hip-joint, with Aseptic Necrosis of the Head of the Femur. R. Kienböck and A. Selka. Röntgenpraxis, June 15, 1931, III, 541-544.

Aseptic necroses are not infrequently encountered in different diseases and injuries of joints. They are of great importance as influencing the course of the disease and the severity of symptoms. Often these necrotic areas of bone are not diagnosed roentgenologically, but are plainly evident upon examination after their presence has been established. Two cases are described: one in a woman, two years after a fracture of the head of the femur, and the other in a woman with a congenital subluxation of the hip. The aseptic necrosis is, of course, only a complicating feature of the primary lesion.

H. W. HEFKE, M.D.

Morphology of Congenital Coxa Vara. Lothar Kreuz. Arch. orthop. Chir., 1930, XXVIII, 106-127. Abstracted in Zentralbl. f. d. ges. Radiol., Sept. 19, 1930, IX, 243.

For a period of several years, the author observed a child, first brought to him at the age of eight months. The first observation revealed a shortening of the left leg, with external rotation, a normal acetabulum, the neck of the left femur being separated from the acetabulum by a greater distance than that of

cent of cases in spite of the best efforts of army surgeons. The author noted and remembered, however, that two such cases did surprisingly well when, through accident, they lay seven days on the battlefield without food, water, or medical attention, but with the presence of many thousands of maggots in their wounds.

Napoleon's Larrey had seen maggots helping Nature heal wounds of French soldiers early in the nineteenth century. Wellington's Millingen saw no good in maggots encountered when the English wounded retreated from Talavera in the heat of July, 1809, and even learned from the Spaniards how to destroy them by pouring olive oil on the dressings. Keen thought that maggots in the Civil War wounds of Union soldiers were harmless but disgusting. Zacharias, on the other hand, considered maggots the most effective cleansing agent at his disposal and deliberately introduced them into the wounds of Confederate soldiers.

Knowing this, the author, in September, 1928, used maggots to treat four cases of chronic osteomyelitis. First, the wounds were opened and all dead tissue removed. Then maggots were introduced. In six weeks' time the wounds were completely healed.

In a second series the following year three cases were complicated by gas bacillus infection and eight by tetanus, and, though all recovered, it was obvious that in the future only sterile maggots could be used.

Masses of eggs that had been deposited on raw beef were hatched under conditions of controlled temperature and humidity. The larvæ were fed on beef until pupæ developed, and the flies that emerged five to seven days later were used to provide more eggs.

When such eggs are placed in test tubes and gently agitated for thirty minutes in a mixture of one to two thousand parts bichlorid of mercury, 25 per cent alcohol, and 0.5 per cent hydrochloric acid, their outside is sterilized and larvæ hatched from them are sterile inside and out. The larvæ feed for two days on a sterilized mixture of liver, beef, agar, and yeast, during which time they are tested for sterility. On the third day, they are ready to be

placed in wounds, or they may be held inactive for several days by placing them in a 40° F. refrigerator. In preparing wounds, soap and water are used to remove dirt and grease, but antiseptic chemicals are avoided because of their harmful effects on the larvæ. Skin edges are taped with adhesive so that the maggots will not tickle the patient, and padded, open-topped cages are firmly attached to the wound. The open top of the cage admits the air needed by the maggots and the sunlight or artificial light that warms them and drives them deep into the wound for food and shade.

In twenty-four hours the reaction of the wound becomes alkaline. Later the bacterial count falls. All dead material is eaten up and fresh live granulation tissue develops. At the end of the fifth day the larvæ, being about ready to become pupæ, are removed and fresh maggots are added. After repeating this for about six weeks the wound heals.

Acute osteomyelitis is said to run a shorter course if maggots are introduced into the surgical wound five days after the first incision into the bone. In old tuberculous lesions, at least the complicating pus infection is improved.

PAUL C. HODGES, M.D.

BONE TUMORS (DIAGNOSIS)

Osteogenic Sarcoma: An Observation on the Lower Extremity of the Femur. Pedro Chutro and Ernesto Cornejo Saravia. *Semana Méd.*, December 18, 1930, XXXVII, 1877-1883.

Disarticulations or amputations in cases of osteogenic sarcoma are not performed for the purpose of preventing further growth, but to relieve pain, prevent pathologic fractures, for psychologic reasons, etc., since sarcomas always metastasize. This metastasis probably comes from the gelatin-like edema around the tumor. The authors believe that such edema represents the plasma of the tumor. Although metastasis appears soon after amputation or disarticulation, they believe that (though unable to prove it) such metastasis exists before operation. They base this on the fact that the patients do not improve after opera-

fractures take place without a trauma sufficiently painful to be remembered by the patient.

The group of diseases called "epiphyseal necroses," including Köhler's disease and Perthes' disease, might be caused by a very similar mechanism. "Silent" fractures might lead to necrosis of certain portions of the bones. A fracture in the small bones of the foot or wrist can easily escape roentgenologic demonstration and may be shown only after the malacia has taken place. Perthes' disease of the hip has been explained by non-infected embolisms or endocrine disturbances. In this case also, the authors think a traumatic genesis much more probable.

H. W. HEFKE, M.D.

Parathyroid Tumors in Recklinghausen's Osteitis Fibrosa. I. Snapper. *Wien. klin. Wchnschr.*, 1930, I, 312-314. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 266.

This is a report of a surgically cured case of generalized osteitis fibrosa cystica with pseudo-malacia. The unusually high calcium content of the serum (from 20 to 23 mgs. per cent) called attention to the hyperfunction of the parathyroid. Mandl and Gold had reported similar cases. Differentiation from the other types of osteitis fibrosa can be established by the fact that in them the blood and urine calcium show little departure from normal.

H. C. OCHSNER, M.D.

Possible Etiologic Factors in the Production of Pulmonary Osteo-arthritis. Edward L. Compere, W. E. Adams, and C. L. Compere. *Pros. Soc. Exper. Biol. and Med.*, June, 1931, XXVIII, 1083, 1084.

The authors were unsuccessful in their attempts to produce the following: (1) New periosteal bone by pressure upon a lung from a foreign body in the pleural cavity; (2) stenosis of a primary or secondary bronchus; (3) collapse or total absence of a lobe, or of

an entire lung; (4) pleurisy with effusion, and (5) solitary lung abscess.

From 100 to 300 c.c. of paraffin were injected into the right pleural cavity of each of nine dogs. A pleural effusion resulted in every case, which, in addition to the mechanical pressure on the lung by the paraffin, almost completely displaced the air-containing tissue in the right lung. Frequent X-ray examinations failed to reveal any evidence of new bone formation along the shafts of the long bones. Blood chemistry studies showed no changes in the calcium, phosphorus, carbon dioxide, and H ion concentration of the blood serum.

Collapse of the lobes of the lungs of thirteen dogs was accomplished. A lung abscess developed in one case and lobectomy was performed upon five dogs at varying intervals, following collapse of the lobe or of the corresponding lung. Roentgenograms and blood chemistry studies revealed no changes similar to those described as pulmonary osteo-arthritis.

J. N. ANÉ, M.D.

BONE DISEASES (THERAPY)

The Acro-osteopathies. Antonio Merlini. *Arch. orthop. Chir.*, 1930, XXVIII, 73-83. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 267.

The author classifies epicondylitis of the humerus and femur as acro-osteopathies, both having a typical roentgenologic appearance. Treatment should be conservative, roentgen therapy and diathermy being indicated. The prognosis is good if the part be put at rest.

H. C. OCHSNER, M.D.

The Treatment of Chronic Osteomyelitis with the Maggot (Larva of the Blow Fly). William S. Baer. *Jour. Bone and Joint Surg.*, July, 1931, XIII, 438-475.

This posthumous publication describes Baer's famous work in detail.

In 1917, war wounds involving compound fracture of the femur caused death in 80 per

encouraging signs of the effects of treatment. When these are accompanied by a retardation or cessation of bone destruction by the tumor cells, the result is a very striking one. In all of the four cases reported in this series, increased calcification and ossification were noted in the radiograms, together with apparent retardation and cessation of bone destruction by the tumor cells. It is usually assumed that the erosive action upon the involved bone is affected by the tumor cells only while they are undifferentiated and rapidly growing, and hence plastic, mobile, and possibly phagocytic, though not in the strict sense of the word as used by Champy.

Some observations made during the treatment of carcinoma with the colloidal solution also led to the conclusion that the young, undifferentiated, and plastic cancer cells were similarly destroyed.

L. J. CARTER, M.D.

CANCER (DIAGNOSIS)

Alkalinity of the Blood in Relation to the Prognosis in Cancer. Editorial. *Jour. Am. Med. Assn.*, June 27, 1931, **XCVI**, 2199.

From studies on healthy persons, as well as on those with acidosis or alkalosis, physiologists may ascribe the neutrality of the blood to a system of acidity regulators or buffers, which, in the case of the blood, consist of mixtures of weak acids and their salts. Governing the acidity or alkalinity of the blood are the ratios of each particular acid to its corresponding salt.

As the hydrogen-ion concentration is but one of the three variables in an equation expressing the acid-base balance of the blood, its measurement has found little use in the clinical laboratory. Neglect of the consideration that it alone is not a safe criterion of a patient's tendencies towards alkalosis or acidosis may be responsible for the discordant opinions as to whether or not alkalosis is a concomitant of cancer.

The work of a group of Philadelphia investigators shows patients with untreated malignant conditions to exhibit a correlation of al-

kaline hydrogen-ion concentration with a shortened span of life. They avoid any assumptions, for they undoubtedly recognize that the prognosis in cancer is somewhat dependent on the degree of co-existing cachexia and anemia, and that a diminution in hemoglobin may effect an increase in hydrogen-ion concentration.

These investigators have reopened a question deserving intensive study.

C. G. SUTHERLAND, M.D.

How Early do Physicians Diagnose Cancer of the Stomach in Themselves? A Study of the Histories of Forty-one Cases. Walter C. Alvarez. *Jour. Am. Med. Assn.*, July 11, 1931, **XCVII**, 77-83.

The patient is slow to realize that he is seriously ill. Many allow themselves to drift along, usually in courses of treatment for supposed ulcer or functional disturbance. After a specified age, routine roentgenologic examination of the stomach might assist, but in actual practice such a regimen seems impossible. Indigestion, abdominal pain, or weakness in the latter half of life demands a careful roentgenologic examination. The tendency to interpret the roentgenologist's report of ulcer as meaning a benign ulcer misleads many physicians. Nearly all patients with benign ulcer have long histories, while nearly all with cancer have short histories.

The great usefulness of the barium meal in the recognition of carcinoma of the stomach is shown by the fact that out of 1,104 patients examined, an operation was ordered for only 14, in the face of a negative roentgenologic report. In 30 per cent of a series, expert roentgenologists were unable to say definitely that the lesion they saw was cancer.

It seems obvious that the only way in which one can hope to cure cancer of the stomach is by excision during the stage when it looks and behaves like a benign ulcer. It would help much if every disturbance of digestion that appears suddenly in a middle aged or elderly individual were looked upon with grave suspicion. It is for the patient with the short his-

tion and that they do not live any longer than those who do not have any surgical interference.

The case here presented is that of a boy sixteen years old who gave the history of a fall. Following this, he developed pain in the knee, which remained until he came to the writers two months later. A tumor about the size of the head of a small child was seen. The radiograph presented a typical picture of osteosarcoma, which had invaded the epiphysis and destroyed the cortex. The film showed light and dark areas; the articulation was not invaded. Disarticulation of the hip was resorted to, the pathologic report being osteogenic sarcoma.

The authors conclude that the cases reported to have lived many years after amputation or disarticulation were wrongly diagnosed, for true osteogenic sarcomas reappear a few months after operation; also, that the edema around the tumor constitutes the plasma of the tumor, and that osteogenic sarcoma, in its late stage, may invade the articulation but never the synovial membrane.

N. G. GONZALEZ, M.D.

A Case of Hemangioendothelioma of the Bones of the Wrist. J. E. Pritchard. *Canadian Med. Assn. Jour.*, May, 1931, XXIV, 689-692.

This is a case report from the Department of Pathology of the Montreal General Hospital.

The patient gave a history of injury to the right wrist while cranking a car. Three months later, a radiograph showed a fracture of the greater multangular and styloid process of the radius, and rarefaction of the lower end of the radius, trapezium, scaphoid, and first metacarpal. Nine weeks later, the condition had progressed. Enlarged lymph nodes appeared in the right axilla and epitrochlear region. One was removed for biopsy and showed hyperplasia but no evidence of tumor. The case was then diagnosed as a bone tumor, probably Ewing's endothelial myeloma, and X-ray treatments instituted. Three treatments, totalling 800 r-units, were given dur-

ing seven weeks, with no response. An amputation was then done through the middle of the forearm.

Microscopically, the tumor was a hemangioblastoma, showing evidence of malignancy. The Committee of the Bone Sarcoma Registry of the American College of Surgeons, who divide the angioblastomas into the benign angiomas and the malignant angioendotheliomas, have classed it as an angioendothelioma.

That this is a rare tumor is evidenced by the fact that, in a series of 1,000 bone tumors from the Bone Sarcoma Registry of the American College of Surgeons, there were only eight angiomas and no angioendotheliomas.

L. J. CARTER, M.D.

BONE TUMORS (THERAPY)

Changes in Bone Tumors after Intravenous Injections of a Colloidal Solution. Arthur C. Hendrick and E. F. Burton. *Canadian Med. Assn. Jour.*, May, 1931, XXIV, 642-646.

This is a report of four cases of bone sarcomas treated by the injection of a colloidal solution. A colloidal solution of metallic arsenic was employed, made by the technic of E. F. Burton, of the University of Toronto. Cataphoresis had shown that the colloidal particles were negatively charged, and hence safe for intravenous injection. Animal experimentation also demonstrated that the solution, when given intravenously, was non-toxic and produced no untoward effects, either immediate or remote.

To demonstrate the changes in the pathology of bone tumors, following a series of intravenous injections of the solution for varying periods, stereoscopic films were made at intervals of about three months, since the radiogram is one of the most important single findings which will at once allow of conclusions as to the changes observed. Biopsy was not considered advisable.

Among present-day research workers in the treatment of bone sarcomas, calcification and ossification are usually looked upon as very

was left open to the air; only one layer of gauze was used.

At the internal canthus, the tubes are placed at a distance of 3 cm. or from 5 to 6 centimeters. The eye is protected with lead.

For cancers of the soft parts, 100 mg., 1 mm. platinum filter, distance 3 cm., 1.5 mc. per sq. cm. of surface. Needles are also used in these cases, employing 0.5 mc. per square centimeter. If the eye is completely involved, it is removed by electrocoagulation or the diathermy knife, and the cavity cleaned out. Radium is then applied in the small 2-mg. tubes, placed 1 cm. center-to-center for a duration of 36 hours.

Of the cases in which the skin alone was involved 100 per cent were cured.

LESTER J. WILLIAMS, M.D.

CHEMICAL

The Allotropy of Rhodium and Some Phenomena Observed in the X-ray Analysis of Heated Metal Wires. F. M. Jaeger and J. E. Zanstra. *Proc. Acad. Sci. Amsterdam*, 1931, XXXIV, 15-32.

Jaeger and Rosenbohm (*Chem. Abs.*, XXIV, 4678) demonstrated that there is a maximum in the $c_p - t$ curve for Pd at 1530° and for Rh at about 1,200°. To determine whether a structural change in the metals takes place at these temperatures X-ray spectrograms by the Debye-Hull method were made of the metal formed under different conditions and after receiving various heat treatments. Powdered Rh from reduction of Rh salts gave broad and hazy diffraction lines suggesting colloidal form. When the powder was wrapped in Pt foil and heated to 1,500° the pattern was the same as that of Rh wire. Two forms of Rh are suggested, α and β , both of which are present at lower temperatures; the α form decreases in amount as the temperature increases until at 1,000° only the β form is present. As a Rh wire was heated the lines in the diffraction pattern were gradually replaced by dots, due to growth of the crystals and their orientation with their axes along the long axis of the wire. At 750° doublets were formed, i.e., the

diffraction lines split into two lines each, one bright and one faint satellite. As the temperature was increased, the ratio of the relative intensities of the components of each doublet was shifted toward an increasing intensity of the satellite in comparison with the first line. The distance between the two lines of a doublet increased with increasing temperature. Rotation of the heated wire caused reappearance of lines in the spectrum where dots had replaced lines as the wire was heated. Pd and Pt showed similar phenomena.

CHEMICAL ABSTRACTS.

Elements of X-ray Analysis by the Powder Method. L. W. McKeehan. *Metal Progress*, 1931, XIX, No. 6, pp. 71-76.

The appearance of a definite pattern with invariable positions and intensities of lines is positive proof of the appearance of a distinct phase. Diagrams are given.

CHEMICAL ABSTRACTS.

Scattering of Gamma Rays. J. C. Jacobson. *Naturwissenschaften*, 1930, XVIII, 951, 952.

The scattering of Ra γ -rays on passing through solutions of various substances was followed by means of an Au-leaf electrometer. A graph of the ionization current against the number of electrons per c.c. gives a smooth curve, showing that the weakening of the radiation is determined by the number of electrons encountered.

CHEMICAL ABSTRACTS.

Luminescence Due to Radio-activity. D. H. Kabakjian. *Phys. Rev.*, 1931, XXXVII, 1120-1128.

The results of several investigations on luminescence due to radio-activity cannot be explained on the active-center theory of Rutherford or any modification of it. In certain substances, including ZnS, there is an initial rise in brightness of the irradiated samples, followed by a decay which cannot be

tory that the experienced gastro-enterologist has learned most to fear.

So long as most physicians are willing to treat epigastric pain in older persons expectantly and without consultation with expert roentgenologists, and so long as they are willing to treat gastric ulcer medically without fortnightly roentgenologic supervision, there can be no hope of lessening the mortality from cancer of the stomach.

C. G. SUTHERLAND, M.D.

CANCER (THERAPY)

Bilateral Embryonal Carcinoma of the Testicle: Report of a Case. J. M. Venable and O. P. Flynt. *Jour. Urol.*, July, 1931, XXVI, 155-161.

The authors report a case of bilateral embryonal carcinoma, in a patient 60 years of age, which followed a history of trauma six years preceding. Both testicles were removed by consecutive operation and the patient made an uneventful recovery. The operative treatment was to be followed up by deep X-ray.

There was no evidence of metastases anywhere in the body.

DAVIS H. PARDOLL, M.D.

Does Carcinoma of the Duodenum Ever Arise from Duodenal Ulcers? J. William Hinton. *Am. Jour. Med. Sciences*, June, 1931, CLXXXI, 843-850.

This article, accompanied by reports from the Mayo Clinic, contains a review of the reported cases of primary carcinoma of the duodenum, and also reports by McGuire, Cornish, Lichty, and many other pathologists on the results of postmortem examination. It has been found that carcinoma of the duodenum occurs in from .027 to .033 per cent of cases.

The author also reviews several cases of his own in which there was carcinoma of the duodenum, the origin of which could not be directly traced to duodenal ulcers. It is dif-

ficult to explain why these cases do not undergo carcinomatous degeneration. While primary carcinoma of the duodenum is occasionally seen, clinically, one can disregard the possibility of the duodenal ulcer ever taking on malignant degeneration.

ROE J. MAIER, M.D.

Treatment of Epitheliomas of the Eyelids. M. Appelmans. *Rev. Belge des Sciences Méd.*, December, 1930, X, 829-839.

At the Cancer Institute of Louvain, in 5,000 cases of cancer, about 100 were found to be of the eyelids. Of these, 75 cutaneous cancers of the eyelids were treated by the author. The ratio of involvement was four of the lower lid to one of the upper. The most frequent location on the upper lid was the external canthus; on the lower, the internal canthus. The majority of the cases on the lower lid did not involve the lachrymal apparatus. Both eyes were involved in about the same percentage, likewise both sexes, the frequency increasing with age.

Of the 75 cases studied by the author, 6 died directly from the effect of the cancer, with involvement of the eyeball. Cancers near the internal canthus are less favorable than those of the external canthus.

The results were as follows: Cured, 27; cured, but with impaired function, 37; failures, 11.

After one year of observation, the final results in 60 cases were as follows: Cured, 27; died, 8; recurred, 4; no response to inquiry, 21. The perfect cures were obtained in cases in which the epithelioma was purely cutaneous.

The following method of treatment was employed: Tubes containing 2 mg. of the element were used. They were 12 mm. long, filtered with 1 mm. of platinum. These were applied for 72 hours. At the external canthus they were applied directly to the skin, being held by adhesive plaster. After-treatment consisted of a wash of peroxide of mercury (1-10), followed by an application of Lassar's paste softened by the addition of an equal amount of vaselin and lanolin. The dressing

expansion coefficient is of the order of 40×10^{-6} , much larger than the same quantity obtained at lower temperatures. Variations in spacing of planes perpendicular to (002) are negligibly small. Reflections due to oblique planes such as (301) or (203) and also second order due to (002) are diminished in intensity in the incandescent state. Some amorphous scattering at the positive electrode was detected. As an explanation of this scattering, the existence of some combination of C with impurities in the molten state is suggested.

CHEMICAL ABSTRACTS.

Change of Wave Length of X-rays on Traversing an Absorbing Medium. J. M. Cork. *Compt. rend.*, 1931, CXCII, 153-155.

The new lines stated by Ray (*cf.* Chem. Abs., XXIV, 4213) to be produced on passing Cu $K\alpha$ radiation through C, etc., were not obtained when his experiment was repeated, nor could any such effect be obtained with B.

CHEMICAL ABSTRACTS.

Anomalous X-ray Diffraction Intensities. W. A. Wood. *Nature*, 1931, CXXVII, 703.

The X-ray Debye photograph of gray mat deposit of Cr on wire gave lines of the expected intensities corresponding to the (200), (110) and (211) reflections. The (211) line is unusually broad; this fact indicates submicroscopic crystals. A similar deposit with brilliant luster gave the same (211) and (110) lines, but no (200) line. It is suggested that the crystals grow in one or two directions only, until the third contains too few reflecting components still to have a noticeable effect in the case of submicroscopic crystals.

CHEMICAL ABSTRACTS.

The Influence of Radiative Forces on the Scattering of Electrons. N. F. Mott. *Proc. Cambridge Phil. Soc.*, 1931, XXVII, 255-267.

Radiative forces are usually neglected in formulas for electron scattering by atoms.

Theoretical and experimental results differ by as much as 40 per cent for large-angle scattering of high-speed electrons, and it was thought that radiation might account for the discrepancy. Complete mathematical treatment shows these forces to be no greater than 2 or 3 per cent for electrons of any velocity. Some remarks are also made about continuous X-ray emission spectra and they are compared with results of Gaunt (*Chem. Abs.*, XXIV, 3951).

CHEMICAL ABSTRACTS.

X-ray Diffraction of Some Organic Substances in the Solid and Liquid States. Shinsuke Tanaka, Genjiro Okuno, and Akira Tsuji. *Mem. Coll. Sci. Kyoto Imperial Univ.*, Ser. A, 1931, XIV, 67-71.

Phenanthrene, α - and β -naphthol and α - and β -naphthylamine were investigated in both the solid and liquid states by means of Debye-Scherrer X-ray photographs. The general conclusions are that a substance which shows an intense crystal line shows also a band in the liquid pattern corresponding to the crystal line, that the spacing of the positions of maximum intensity of the liquid band is generally greater than that of the corresponding crystal line, and that the crystal planes seem to maintain their properties when the crystal becomes liquid.

CHEMICAL ABSTRACTS.

The Dependence of X-ray Absorption Spectra upon Chemical and Physical State. J. D. Hanawalt. *Phys. Rev.*, 1931, XXXVII, 715-726.

The X-ray absorption spectra of As, Se, Br, Zn, Hg, Xe, and Kr and of compounds of some of these elements have been photographed for both the solid and the vapor states at a dispersion of 5 x. u. per millimeter. The effect of the chemical and physical state of the absorbing atom upon the secondary structure which lies to the short wave side of the main absorption edge was investigated. It was found that: (1) the monatomic vapors Zn, Hg, Xe, and Kr exhibit no secondary structure

represented by a simple exponential curve. The rate of decay of brightness is not strictly proportional to the rate of emission of luminous energy, as required by the theory. The observed facts can be explained qualitatively by assuming that the α -, β -, and γ -rays produce excited molecules in the luminescent material. The luminous energy is emitted on the return of the molecule to its initial state. The rays also affect the transmission coefficient of the materials and the apparent decay of brightness is explained as being due to the increased absorption of light by the material itself rather than to the destruction of assumed active centers. The author believes that the restoration of the original brightness is attested to by this fact.

CHEMICAL ABSTRACTS.

Ionization by X-rays Crossing the Thin Walls of a Small Sphere. W. Mund. *Bull. Soc. Chim. Belg.*, 1930, XXXIX, 518-528.

An equation has been established, which makes it possible to compute the ionization around a small sphere filled with Rn.

CHEMICAL ABSTRACTS.

Polarization in Photo-electric Conductivity Arising from X-ray-excited Rock Salt. P. Tartakovskii. *Ztschr. Physik*, 1930, LXVI, 830-833.

A thin plate of rock salt was placed between the poles of an electromagnet, and the Hall effect was used to give a preponderance of free electrons towards one side of the plate. When the magnetic field was removed, the corresponding half of the plate showed a lower conductivity. Hence free electrons increase the polarization.

CHEMICAL ABSTRACTS.

Dangers in Refining Radio-active Substances. Herman Schlundt, William McGavock, Jr., and Mildred Brown. *Jour. Ind. Hyg.*, 1931, XIII, 117-134.

The investigations were carried out over a

period of three years in a laboratory where the final stages of refining commercial MgTh in 100- to 300-mg. quantities were carried out. Gamma radiations and the radio-active gases, radon and thoron, were the sources of danger. Precautions were taken to reduce these dangers to a minimum and then the laboratory atmosphere and workers were carefully examined for radiation. The thoron content was 10^3 greater than the radon content and constituted the chief danger, as the gamma radiation was small. A method for the determination of thoron in the laboratory atmosphere was devised and showed 10^{-4} curies of thoron per cubic meter as a representative value, and under these conditions the lungs of a worker will contain 9×10^5 atoms of thoron and 1,400,000 α -particles will be produced per minute, which is approximately 2 per cent of the number occurring in the body of a person carrying an amount of Ra just within the limits of tolerance. Workers were examined monthly by the γ -ray method (less reliable) and the expired-air method. The latter method gives a timely warning of danger sooner and more accurately than any other. Workers develop a distinct radio-activity with time, but lose it gradually. One worker showed, by the expired-air method two days after stopping work in the laboratory, a net drift of 22 divisions, but three months later only 1.9 divisions. Blood counts of three workers showed no abnormalities. None of the five workers experienced any debilitating effects. Previous workers in the laboratory before precautions were used did not show any harmful effects ten years after ceasing work.

CHEMICAL ABSTRACTS.

X-ray Diffraction by Incandescent Carbon. Moriso Hirata. *Sci. Papers Inst. Phys. Chem. Research, Tokio*, 1931, XV, 219-226.

X-ray diffraction photographs obtained from the incandescent positive and negative electrodes of the C arc were studied. The thermal expansion of graphite takes place only in the direction perpendicular to the most closely packed plane (002), and this average

the thickness of the absorbing layer is such that the difference in the transmitted intensity on the two sides of the edge is a maximum. Ni, Co and Fe were used in a study of this effect.

CHEMICAL ABSTRACTS.

Influence of Radium on Subacute Arsenic Poisoning. B. Boucek. *Compt. rend. Soc. Biol.*, 1930, CIV, 235-237.

Ra in the form of pitchblende was administered to guinea pigs simultaneously with As in successive doses to the limit of ordinary arsenical tolerance. About 2.4 mg. As per kg. is fatal in three days; but in combination with 1.6 mg. pitchblende a dose of 3.1 mg. As is well tolerated, and the animal improves in weight. However, in certain cases Ra interferes with the acquirement of tolerance for As; and when As is insufficient in amount to cause subacute poisoning, the addition of Ra makes it more toxic.

CHEMICAL ABSTRACTS.

X-ray Absorption in Gases. W. W. Colvert. *Phys. Rev.*, 1930, XXXVI, 1619-1624.

X-ray spectral lines reflected from a Pt-surfaced mirror and by a calcite crystal have been used for absorption measurements with Ne, SO_2 , Cl and A. Results are given in tabular form.

CHEMICAL ABSTRACTS.

The Wave Length and Structure of the K-absorption Edge of Cobalt. M. A. Valouch. *Collection Czechoslov. Chem. Comm.*, 1931, III, 205-215.

A study has been made of the wave length and structure of the X-ray K-absorption edge of Co, in the form of metallic films as well as in alcoholic and aqueous solutions of $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$. Respective values in x. u. of the wave lengths of the absorption edges due to the different forms in order named are: 1604.4, 1602.6 and 1602.2. The fine structure of the K-absorption edge, which has been ob-

served in all cases, is relatively more noticeable for the solutions than for metallic Co, a difference which may possibly be due to the thickness of the absorbing layer.

CHEMICAL ABSTRACTS.

The Atomic Photo-electric Effect with Great Hardness of the Exciting Radiation. Fritz Sauter. *Ann. Physik*, 1931, IX, 217-248.

A method is devised for obtaining the wave function of an ejected photo-electron in closed form, using non-relativistic polar coördinates. Photo-emission from the K and L shells is calculated, and the Sommerfeld-Schur formulas (for relatively soft exciting radiation) are shown to be first approximations. The relativistic theory of the photo-electric effect in conjunction with Dirac's equations is also developed.

CHEMICAL ABSTRACTS.

The Intensity of X-rays Reflected from Platinum, Silver, and Glass. Hiram W. Edwards. *Phys. Rev.*, 1931, XXXVII, 339-343.

The intensity of a monochromatic beam of X-rays reflected from Pt, Ag, and glass mirrors was measured for angles of incidence varying from 0.75 to 1.25 times the critical angle. Calculated values by Thibaud's modification of Fresnel's equation agree with experimental values for Pt but not for Ag or glass mirrors.

CHEMICAL ABSTRACTS.

Observations Concerning the Causative Agent of a Chicken Tumor. James B. Murphy, O. M. Helmer, Albert Claude, and Ernest Sturm. *Science*, 1931, LXXIII, 266-268.

This is a report of additional observation on the properties of a filtrable agent causing chicken tumor. The agent of Chicken Tumor I, a spindle-cell sarcoma, is selectively adsorbed and fixed by certain mesodermal tis-

at a distance from the main edge greater than the ionization potential of the atom; (2) polyatomic vapors usually have a secondary structure similar to that shown by the same molecule in the solid state; (3) a polyatomic molecule in the solid state often exhibits an additional structure which is absent when the molecule is in the vapor state; (4) in the secondary absorption of solid NaBrO_3 an additional structure appears which is absent in a solution of NaBrO_3 ; (5) completed electron shells of atoms in the solid state do not necessarily mean the absence of secondary absorption edges. Suggestions are made to account for this dependence of secondary absorption on molecular and physical state.

CHEMICAL ABSTRACTS.

Crystal Chemistry and X-ray Research. V. M. Goldschmidt. *Ergebnisse tech. Röntgenkunde*, 1931, II (separate), 151-182.

Except for incidental discussion of more recent work, this is largely a restatement of previous discussions of the modern explanation of the early empirical rules of crystal chemistry, the basis for co-ordination numbers, the co-ordination types as a basis for classification of crystals, the relation of various crystal properties to the properties, including polarization, of the particles contained. The use of recent concepts in studying silicates, intermetallic bonds, and highly polymerized organic structures is discussed. Tabulations are given of ionic and atomic radii. A bibliography of what the author considers the most important work in the field since 1928 is given.

CHEMICAL ABSTRACTS.

X-ray Study of the Coagulation Process of Colloidal Gold. P. Scherrer and H. Staub. *Ztschr. physik. Chem.*, 1931, Abt. A, CLIV, 309-321.

During coagulation of a highly disperse Au sol, the primary particles of the hydrosol form larger secondary particles of irregular structure. The primary particle size remains unchanged. Formation of larger crystals from

primary particles takes place during intensive drying at room temperature or if the coagulate is left in an electrolyte-containing solution. The velocity of crystallization depends on the nature of the initial sol. The velocity can be increased by raising the temperature. Protective colloids prevent the formation of larger crystals.

CHEMICAL ABSTRACTS.

X-ray Diffraction in Water: The Nature of Molecular Association. G. W. Stewart. *Phys. Rev.*, 1931, XXXVII, 9-16.

The X-ray diffraction intensity-angle distribution for water and its variation for temperatures of 2 degrees to 98 degrees are given. Two important periodicities are established at 3.24 and 2.11 Å.U. and a third at 1.13 Å.U. The first one decreases with temperature and the second increases. Molecular complexes are discussed. The author believes that the description of associations involving complexes of two or three molecules should be abandoned in favor of the molecular group conception (cybotactic state).

CHEMICAL ABSTRACTS.

Appearance of Extra Lines in X-ray Diffraction Patterns of Mixtures and Absence of Some Lines Peculiar to the Components of the Mixtures. Roy W. Drier. *Phys. Rev.*, 1931, XXXVII, 712-714.

Abnormalities in X-ray patterns of mechanical mixtures of minerals are described. The spectra of some show the presence of extra lines and in the spectra of others some lines peculiar to the components are missing. Possible reasons for this are discussed.

CHEMICAL ABSTRACTS.

The Fine Structure of X-ray Absorption Edges. J. Palacios and M. Velasco. *Anales Soc. Españ. fis. Quím.*, 1931, XXIX, 126-130.

It is pointed out that the fine structure of X-ray absorption edges, in all substances reported up to the present, first shows up when

the ribs is more likely to become obliterated in adults than in children.

Lateral roentgenograms are essential for the study of interlobar and medial encysted effusions. The interlobar type, corresponding to one of the normal fissure levels, is seen on the postero-anterior roentgenogram as a band-like shadow of increased density across the affected hemithorax, while a medial encysted effusion appears as an additional shadow of increased density overlying the normal inferior mediastinal and heart shadows.

J. N. ANÉ, M.D.

Foreign Body Granulations in the Lung after Diagnostic Bronchography. E. Morvay. *Röntgenpraxis*, July 1, 1931, III, 581-586.

Four months after bronchography with iodipin a large amount of the contrast medium was still present in a woman with a thoracic tumor. It was found on the side opposite the one filled during the bronchoscopy. There had been no difficulty at the time. After the bronchography some of the contrast material was aspirated into the other side during a coughing spell, and a large part of it was retained in the right lung. The clinical and roentgenologic picture of a foreign body granulomatosis developed afterwards and remained constant for one year. It is pointed out that the demonstration of the bronchial tree by means of iodine-containing contrast media might lead to such undesired after-effects and that one should use the method only when it is definitely indicated.

H. W. HEFKE, M.D.

The Interrelationship of Non-tuberculous Upper and Lower Respiratory Disease. Jabez H. Elliott. *Canadian Med. Assn. Jour.*, May, 1931, XXIV, 657-659.

It is difficult to classify the various methods by which disease in the upper respiratory tract leads to disease in the lower respiratory tract. The relationship appears very clear in such cases as acute rhinitis, where the infection spreads rapidly, or at times slowly, down-

ward, with successively a pharyngitis, a laryngitis, a tracheitis, at times a bronchitis, a bronchiolitis, or a pneumonia. Nasal obstruction from any cause, leading to mouth breathing, results in the aspiration into the bronchial tree of air insufficiently warmed or filtered, and of relatively low humidity. This causes a hyperemia of the bronchial mucosa, with increased secretion and the symptoms of a subacute bronchitis. We have to consider, too, the aspiration of septic material into the bronchial tree from the upper passages, whether this be secretion from post-nasal and oral dripping, or infected material dislodged during the course of some operation in the oro-nasal cavities. Spread may also occur to the lungs through the blood and lymph streams, explaining some of the cases of pulmonary abscess which follow oro-nasal sepsis.

Lobar Pneumonia.—The study of a large series of cases in various hospitals reveals that in over 50 per cent there had been a cold or sore throat for several days before the onset of pneumonia.

Pulmonary Abscess.—This is a frequent result of nasal sepsis. The author reported 47 consecutive cases of pulmonary abscess, in which 32 had followed operations on the oro-nasal cavities. Lord, in an analysis of 227 cases, found abscess a sequel to tonsillectomy in 34.3 per cent of the cases.

Asthma.—When we place in one group those cases of allergic asthma due to pollens, feathers, and other epidermals, and food, there is still a large group in which no definite sensitiveness to protein can be demonstrated. A large proportion of this group will be found to have associated nasal disease. Four cases are cited to illustrate the relief secured from the removal of nasal infections, such as empyema of the antra and ethmoiditis.

Recurring Bronchitis.—In this large group of cases, chronic nasal infection is a common source of infection. Five cases are reported, illustrating relief from chronic bronchitis secured through the removal of nasal infection.

Bronchiectasis.—Clendenning has made the startling statement that in 150 cases of bronchiectasis, varying in severity, all were asso-

sues from susceptible animals. The plotted curve of the amount of ultra-violet light of selected wave lengths required to inactivate the tumor agent shows a significant qualitative and quantitative variation from the curves for bacteria, typical viruses, and bacteriophage. The tumor-producing activity of the filtrates can be precipitated out with a protein fraction and purified. The steps in the purification of the agent are outlined and the evidence of an inhibiting principle in the chicken tumor is discussed.

CHEMICAL ABSTRACTS.

Scattering of X-rays from Gases. E. O. Wollan. *Phys. Rev.*, 1931, XXXVII, 862-872.

Measurements have been made of the intensity of scattering of X-rays by H₂, O₂, He, Ne and A for the scattering angles 10° and 90°.

CHEMICAL ABSTRACTS.

Technical Considerations in the X-ray Testing of Materials (II). A. Herr. *Mitt. staatl. tech. Versuchsanst.*, 1930, XIX, 60-78.

A discussion of the introduction of X-ray equipment into technical laboratories for testing materials. Apparatus for investigating the gross structure of large parts is described, including a stereobinocular set-up for locating defects accurately. Metallic X-ray tubes equipped with protective mantels for high tension are shown.

CHEMICAL ABSTRACTS.

Diffraction of X-rays in Liquids; Effect of Temperature. E. W. Skinner. *Phys. Rev.*, 1930, XXXVI, 1625-1630.

The effect of temperature upon X-ray diffraction has been examined for mesitylene, 4-hydroxy-1,3-dimethylbenzene, 2-hydroxy-1,3-dimethylbenzene, phenol, naphthalene, benzene, cyclohexane, dipropylcarbinol, heptylic acid, *tert.*-butyl alc., lauryl alc., octane, 2,7-di-

methyloctane and 2,4-trimethylpentane. Results and conclusions are discussed.

CHEMICAL ABSTRACTS.

Theory and Practice of X-ray Analysis. William H. Barnes. *Canadian Chem. Met.*, 1931, XV, 67-70.

A short review with brief mention of some of the fundamental conceptions on which the subject is based and an outline of a few of the fields of application. The production, nature of X-radiation and physical chemistry and biologic effects thereof are discussed. Applications to spectroscopy and crystallography are noted.

CHEMICAL ABSTRACTS.

CHEST (DIAGNOSIS)

Roentgenologic Diagnosis of Pleural Effusions. Joseph W. Post. *Jour. Am. Inst. Homeop.*, June, 1931, XXIV, 580-582.

A roentgenologic study of pleural effusion depicts increase or decrease of fluid, amount of lung compression and displacement of surrounding organs, re-establishment of lung expansion, and the formation and location of any subsequent pleural thickening, adhesions, or calcareous infiltration. The author stresses the importance of the fluoroscopic examination and lateral roentgenograms, in addition to the postero-anterior examination. Increase of fluid is observed, due to elevation of the area of generalized increased density and a characteristic upper border, taking the form of a slightly concave oblique line extending from above downward and from the thoracic wall inward toward the lung root. This curved upper border is not found in the encysted type of pleurisy, a distinct fluid level being noted in the presence of a pneumothorax.

In the pre-exudation stage, fluoroscopy will show an immobilization of the diaphragm in all forms of effusion of inflammatory origin. The density of an effusion is nearly uniform, being more intense at the base. The shadow of

such cases, in the authors' opinion. Such a calcification follows the primary disease usually by many years.

A diagnosis *in vivo* can only be made by a roentgenologic examination (fluoroscopy and roentgenogram). Extent, shape, and situation of such calcified areas in the pleura are variable. A differential diagnosis from intrapulmonary calcifications and rib-callus must be made. Interlobar calcifications sometimes are difficult to separate from other calcifications of the pleura. In 4,500 roentgenologic examinations of the chest, 8 cases of calcification of the pleura were seen. The relative frequency of such an occurrence is about 0.18 per cent. In 3 cases, an old injury of the thorax and in 2 cases, an old pleurisy were the etiologic factors. In 3 cases, there was no history of lung or pleural disease.

H. W. HEFKE, M.D.

Lateral X-ray of the Chest to Localize Intrathoracic Conditions. A. Jaubert de Beaujeu. *Jour. Radiol. et d'Electrol.*, March, 1931, XV, 129-140.

The author calls attention to the fact that, due to increased interest in the heart and blood vessels, the oblique instead of the true lateral radiograph of the chest is taken.

It is important to take a true lateral view to locate the exact pathologic process in the chest, as this is the only position which gives a view of the posterior and anterior mediastinum and the base of the lungs posteriorly. The article is well illustrated.

LESTER J. WILLIAMS, M.D.

CONTRAST MEDIA

Intravenous Pyelography by Intravenous Injections of Uroselectan and Pyelognost. Carlos Heuser. *Semana Méd.*, May 22, 1930, XXXVII, 1326-1331.

This method has been used very extensively in Germany, since 1928, and the author has been working on it to compare results. The

conclusions which he arrived at do not agree with those reported in Germany.

By injecting 3 grams of pyelognost in rabbits and taking films every 5, 10, 15, 20, 25, 30, 45, 60, 100, and 180 minutes, he has been able to obtain good visualization of kidneys and gall bladder at 25 and 30 minutes, though they showed faintly at 5 minutes. At 60 minutes, a good film of the bladder was obtained. Using smaller amounts of pyelognost—2 grams—the gall bladder did not show. With uroselectan, using varying doses of from 2 to 5 grams, the kidneys did not appear outlined in radiographs taken up to 5 hours after the injection, but the bladder showed well at one hour. On a patient injected with 30 grams of uroselectan in 80 c.c. of water, beautiful pyelograms were obtained at 5, 10, and 15 minutes. The author states that intravenous pyelography is indicated in persons who refuse to be cystoscoped and that uroselectan gives excellent results.

N. G. GONZALEZ, M.D.

A Rare Accident from Taking Capsules of Tetraiodophenolphthalein. Carlos Heuser. *Semana Méd.*, June 5, 1930, XXXVII, 1448, 1449.

Most of the accidents from this drug have been in either the stomach or intestine. The case herein presented is interesting in that it occurred somewhere else. A woman, 60 years of age, was advised to take tetraiodophenolphthalein capsules for the purpose of gall-bladder visualization, because she gave a history of gall-bladder stones. She was in bed when she took the first capsule, and believed that it went into her lungs. A few moments after swallowing it, she had severe pain in the throat, and could not talk; there was a feeling of constriction about the throat, and shortness of breath. In half an hour, she was improved, but the burning remained. The next day, she was examined, and edema of the vocal cords and a blue line in the larynx were found. Antero-posterior and lateral radiographs were made. In the latter, there was found a shadow extending from the fourth cervical vertebra to the insertion of the

ciated with long-standing nasal infection. The author requests a rhinologic examination in all cases of bronchiectasis, finding in most of the cases an associated sinusitis, with a history of nasal infection or symptoms of long standing.

L. J. CARTER, M.D.

Pulmonary Manifestations of Lymphogranulomatosis. Erich Saupe. *Klin. Wchnschr.*, 1930, II, 1495-1499. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Dec. 12, 1930, IX, 602.

In ten cases the following conditions were found: (1) Direct extension of mediastinal tumors into the lung; (2) pulmonary foci separate from the mediastinum; (3) the disseminated type which may be accompanied by effusion. The diagnosis was from microscopic section rather than by roentgen examination. The differential diagnosis was chiefly between hilus carcinoma, with mediastinal metastasis, and tuberculosis. Roentgen therapy is effective in pulmonary as well as in glandular involvement.

H. C. OCHSNER, M.D.

Semeiology and Radiographic Diagnosis of Benign Anatomic-clinical States. Guillermo Bosco. *Prensa Med. Argentina*, June 10, 1931, XVIII, 46-55.

In this article, the author considers only lesions of the respiratory tract, primarily in connection with the differentiation of benign from malignant lesions. As is well known, any pathologic condition of the bronchi, alveoli, or pleura gives rise to anatomic alterations which cause a condensation in the organ. Such changes produce impressions on the X-ray plate which do not always make a diagnosis clear. Sometimes it is difficult to say whether the lesion is benign or malignant, particularly since X-ray findings and symptomatology are not considered simultaneously. Radiographs, however, can usually demonstrate the presence or absence of tumors.

The author goes into detail about several lesions, but the valuable point in the article is

that he presents the fact that benign lesions may appear anywhere in the lung but never in the mediastinum, because there is *no respiratory tissue there*, while malignant tumors are either attached or involve the mediastinum. So in a radiograph of the chest, this should always be the primary step in making a diagnosis.

N. G. GONZALEZ, M.D.

Roentgenologic Investigation of the Peristaltic Action of Human Bronchi. Seiichiro Mayeda. *Mitt. med. Ges. Tokio*, XLIII, 1703-1818, and *Deutsch. Zusammenfassung*, 1929, pp. 1703-1705. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 262.

In 213 cases of lipiodol injection of the bronchi, fluoroscopic and serio-roentgenographic examinations were made. There is a peristaltic and twisting wave-like motion, the origin being distal to the position of the contrast medium. Peristalsis starts immediately after injection. Changes in the peristalsis are due to variation of bronchial tonus. There is anti-peristalsis in bronchiectasis, noted especially at the orifices of the cavities. Peristalsis continues in all phases of respiration, in each systole the bronchi of the left lower lobe showing an increase in peristalsis. Peristalsis is activated by any vagus stimulant and inhibited by sympathetic stimulation.

H. C. OCHSNER, M.D.

CHEST (GENERAL)

Calcification of the Pleura. Gustav Velde and Walther Schlopsnies. *Röntgenpraxis*, July 15, 1931, III, 634-642.

Calcification of the pleura takes place by incrustation of the pleura with calcium salts, especially in the central, poorly vascularized portions of scars (dystrophic calcification, according to M. B. Schmidt); however, it may occasionally be found without marked pleural thickening. It represents the final outcome after an exudative pleuritis, an empyema, or a hemothorax. A general tendency of the body to deposit lime salts cannot be found in

the principal locations in the male, and the urethra and cervix in the female. A detailed description is given of each technical application. The author reports cure of the gonococcal arthritis in the fifty-two cases which were treated. Some of these, however, had permanent structural changes. Gonococcal orchitis and epididymitis yielded rapidly and satisfactorily to diathermy treatment. Gonococcal salpingitis, where no pus or pent-up fluid was present, was symptomatically relieved.

WILLIS S. PECK, M.D.

DOSAGE

Action of X-rays on Tissue Cultures *in vitro*. L. Doljanski, J.-J. Trillat, and Lecomte du Noüy. Compt. rend. Acad. Sci. Paris, 1930, CXC, 1147-1150. Abstracted in Zentralbl. f. d. ges. Radiol., Sept. 19, 1930, IX, 247.

Pure cultures of fibroblasts were subjected to unfiltered radiation at 28 P.K.V., 30 ma., and F.S.D. 4 cm., and studied at from 12 to 24 and 48 hours after irradiation. By increasing the dose, the latent period was shortened. Irradiation of one minute produced definite damage, the lethal dose being five minutes. The effect was on the tissue itself, not on the culture medium, for irradiation of the solution alone produced no effect.

H. C. OCHSNER, M.D.

Divided Dosage in Radium Therapy. Albert Eidinow and J. C. Mottram. The Lancet, June 6, 1931, CCXX, 1236-1238.

The authors have found that fewer milligram-hours are required to produce an erythema when the intensity of radiation is high than when it is low. Intensity of a few milligrams per centimeter exposure extending over several weeks will not produce an erythema. Similar results were obtained with a strong applicator by giving a number of small doses once daily or once a week.

Working with Jensen's rat sarcoma, experiments were conducted to determine its reaction to divided doses. Tables giving skin re-

actions show the difference between single and divided doses, and figures show the results of divided and single doses from the following experiments: Two tumors measuring 60 square millimeters were taken. One received fifteen hours gamma-radiation. The second received three exposures of five hours at two-day intervals. Both disappeared at approximately the same time. Three tumors of 20 square millimeters were similarly treated. The tumor receiving the divided dosage disappeared more rapidly than the tumors receiving one dose. Five more tumors were dealt with using twelve hours and three periods of four hours each. One tumor receiving twelve hours in one dose after retarded development grew into a larger tumor. A second twelve-hour radiated tumor persisted for a longer period than the tumors receiving divided doses. Other series of radiation were similar to those described.

Conclusions are drawn that Jensen's rat sarcoma is as sensitive to divided doses as to a single dose within the limits of the experiments, and that the overlying skin receives less injury from radiation of a tumor with a view of causing its disappearance. A much larger dose of radiation can be set free in a tumor without production of skin erythema by divided doses than by a single exposure. The authors suggest that in application of radium or X-ray in treatment of tumors, divided doses should be given a thorough trial, but the optimum time interval and size of dose can be discovered only by clinical research.

H. J. ULLMANN, M.D.

EXPERIMENTAL STUDIES

Therapeutic Application of the Antagonism of Various Types of Irradiation. Lodovico Armani. Riv. Radiol. e Fisica Med., 1930, II, 211-219. Abstracted in Zentralbl. f. d. Ges. Radiol., Sept. 19, 1930, IX, 246.

This is a report of further studies on the antagonism between visible infra-red and roentgen rays on the seeds of *Pisum sativum*. Roentgen-irradiated Sabouraud-Noiré tablets were changed from Tint A to Tint B in 10

first rib. The trachea was found anterior to the shadow.

The author concludes that the patient probably retained the capsule in her mouth for a while so that when she swallowed it, it broke. Thus some of the dye came in contact with the vocal cords, the rest going down the esophagus. The patient recovered in a few days' time.

N. G. GONZALEZ, M.D.

Intravenous Pyelography. Carlos Heuser. *Semana Méd.*, Jan. 29, 1931, XXXVIII, 327, 328.

The author has previously reported his findings on intravenous pyelography with uroselectan and pyelognost. Herein he presents those obtained with abrodil and "metafan." Abrodil can be given either intravenously or orally, but the latter method is not satisfactory because some of the abrodil remains in the intestine, marring the pyelogram. Other workers on this substance, such as Ziegler, Bronner, Hecht, and others, give 20 gm. of abrodil in 120 c.c. of water, but the author has been able to obtain beautiful pyelograms twenty minutes after injecting with 10 gm. only. The dye appears in the urine a few minutes after the injection and continues to be excreted for only three hours. The dye can also be given rectally in 20 gm. doses with very good results.

N. G. GONZALEZ, M.D.

CYST (HYDATID)

Hydatid Cyst. Rodolfo Dassen and J. C. Rey. *Semana Méd.*, April 10, 1930, XXXVII, 921-926.

This case is here presented because of the rarity of the condition. A woman, 29 years old, developed a burning sensation in the right hypochondrium a week after parturition. This condition lasted three months and disappeared. Four months later, it reappeared, being accompanied by a persistent cough and a left-sided flaccid paraplegia. At this stage, she was

referred to the authors who, clinically, found a mass in the right chest which, by exclusion, they diagnosed as hydatid cyst causing pressure of the cord. X-ray examination showed a non-homogeneous shadow on the right side, which seemed to be pushing the seventh and eighth ribs aside and compressing the cord at about the ninth dorsal segment. The final diagnosis of right extrapleural hydatid cyst compressing the cord was made. Resection of the seventh and eighth ribs was resorted to and the cyst removed. All the symptoms mentioned above disappeared gradually and the patient recovered.

The authors conclude that, whenever any pressure paraplegia is present and the cause cannot be ascertained, hydatid cyst must be kept in mind.

N. G. GONZALEZ, M.D.

DIATHERMY

Bipolar Coagulation of Chronic Endocervicitis. Thomas H. Cherry. *Med. Herald, Phys. Ther., and Endocrine Survey*, July, 1931, L, 288-290.

The author believes that coagulation by diathermy is the method of choice in treating chronic endocervicitis. This procedure does not require hospitalization, although the lesion is not healed until from four to six weeks have elapsed. The technic of using the two electrodes in the cervix is described in detail. The author prefers this method, because the depth of the coagulation in the cervical canal is more easily controlled than with the monopolar method.

WILLIS S. PECK, M.D.

Treatment of Gonococcal Infections by Diathermy. E. P. Cumberbatch. *Am. Jour. Phys. Ther.*, July, 1931, VIII, 97-102.

The author advises the application of diathermy to the foci in cases of gonococcal arthritis instead of applying it to the involved joints. The prostate and seminal vesicles are

regression, as compared with the control group or those treated with non-specific protein.

2. The treatment with thymus extract neither inhibited the growth nor produced regression. Injection of the extract did not prolong the life of the tumor-bearing animals.

3. The suprarenal cortex extracts, the thymus, the omentum-lipoid, and the ox testis extracts neither inhibited growth nor caused regression of the Jensen sarcoma.

4. The rate of ulceration of carcinomatous tumors under treatment with various gland extracts was not greater, as compared with the rate of ulceration of other rats treated with inorganic salts or non-specific protein.

5. The organic extracts studied in experimental carcinoma and sarcoma in rats had no beneficial effect in inhibiting growth of the tumors or their regression, nor did the extracts cause prolongation of the life of tumor-bearing animals, as compared with untreated ones or those treated with non-specific protein extracts.

CHARLES H. DEWITT, M.D.

X-ray Studies of Motility of Gastro-intestinal Tract of Rachitic Rats with Healed Bone Lesions. Leon J. Menville, J. N. Ané, and S. N. Blackberg. *Proc. Soc. Exper. Biol. and Med.*, June, 1931, XXVIII, 932, 933.

The authors made comparative studies of the gastro-intestinal motility of rachitic rats to ascertain whether the motility returned to normal after the bone lesions of the rats were healed.

Preliminary examinations of the gastro-intestinal tract of the rachitic rats with typical bone changes revealed a definite hypomotility in every case. Subsequently each of the animals was given five drops of Viosterol per day, in addition to the original rachitic diet. After a period of ten days, roentgen examination showed that the bone lesions of all the rats were healed, but that the hypomotility previously observed was still in evidence.

J. N. ANÉ, M.D.

GALL BLADDER (NORMAL AND PATHOLOGIC)

Gall-bladder Function. Editorial. *Jour. Am. Med. Assn.*, July 11, 1931, XCVII, 105.

From the results of experiments on various species of animals, Mann estimated that the capacity of the gall bladder was usually less than the amount of bile secreted in half an hour. There is an enormous concentration of bile during its sojourn in the organ.

The evidence is quite conclusive that the gall bladder never completely empties at one time. Ravdin and Morrison favor the conclusion that, although certain constituents of the bile may leave the gall bladder by the lymphatics or the blood vessels, concentrated bile is discharged through the cystic duct as a result of contraction of the gall bladder itself.

C. G. SUTHERLAND, M.B.(Tor.).

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

Some Recent Developments in the Radiologic Examination of the Gastro-intestinal Tract. John O'Sullivan. *Med. Jour. Australia*, June 6, 1931, I, 685-690.

This paper emphasizes the value of radiologic visualization of mucosal changes based on the technics of Forssell, Berg, and Knothe. The white-washing effect delineating the mucosa is obtained by using small quantities of barium mixture, preceded in some cases by gastric lavage.

In the esophagus the diagnosis between cardiospasm, carcinoma, and diverticulum is facilitated. Cardiospasm often shows continuity of the mucosal folds in the region of the cardia.

In atrophic gastritis the mucosal folds are flattened, narrowed, or obliterated, while in the hypertrophic type the mucous membrane is swollen and may show polypoid changes. In the neighborhood of gastric ulcers and carcinomas a wart-like granular surface of the mucosa is often seen.

Convergence of the mucosal folds towards

minutes, by infra-red irradiation, while this was accomplished by ultra-violet in 22 minutes, and by diffuse daylight in 240 minutes. In animal experimentation it was found that animals subjected to lethal doses of X-ray survived if the X-ray was followed immediately by infra-red irradiation. After a roentgen skin injury, one part of the injured skin was subjected to infra-red, which region healed quickly in contrast to the unirradiated part. In several cases of carcinoma, the author used two to three H.E.D. of X-ray, followed immediately by infra-red. The only skin effect was an extensive pigmentation.

H. C. OCHSNER, M.D.

An Experimental Study of the Relative Intensities of X-ray Lines in the Tantalum L-spectrum. Victor Hicks. *Phys. Rev.*, 1930, XXXVI, 1273-1284.

The relative intensities of seventeen lines in the L-spectrum of Ta have been investigated by the ionization spectrometer. Intensity results are given.

CHEMICAL ABSTRACTS.

The Rachitic Factor in the Development of Tumors. A. H. Roffo. *Prensa Med. Argentina*, June 10, 1931, XVIII, 57-63.

The author has worked for many years on the relation of diet to growth of tumors. He believes that nutrition, if not the cause, at least plays a very important rôle in the growth of tumors. He points out the fact that tumors are rich in lipoidal substances and that in certain races, such as the Vasques and Irish, who eat food containing large amounts of lipoids, cancer is very frequent.

In this particular article, he presents his findings—including radiographs—of the rachitic diet on rats. To thirty rats he gave a normal diet, and to another thirty he gave polished rice only. The first number grew normally to an average of from 150 to 180 grams, while the second group attained only from 40

to 50 grams. Radiographs taken showed convincing evidence of rickets in the latter. The transmission of tumor (sarcoma and carcinoma) was made to both normal and rachitic rats. The results were that both these tumors were much larger in the animals with normal diet. The weight of the sarcoma in those with normal diet was from 45 to 50 grams, while in the rachitic ones, it was from 1.10 to 3 grams. The carcinoma weighed about 23 grams for the first group and 1.5 grams for the second group. It is also interesting to note that sarcoma occurred in 100 per cent of the normal rats and in only 80 per cent of the rachitic ones, while carcinoma occurred in 75 per cent of the former and 25 per cent of the latter.

N. G. GONZALEZ, M.D.

Gland Extracts in Experimental Carcinoma and Sarcoma of Albino Rats. O. M. Gruhzt. *Ann. Int. Med.*, June, 1931, IV, 1589-1597.

A series of albino rats were inoculated with Flexner-Jobling carcinoma or Jensen sarcoma of rats. When the tumor reached about one square centimeter in size, the animals were divided into three groups and treated. One group was treated with the suprarenal cortex hormone extract, the second group was an untreated control group, and the third group was treated with an extract of ox testis as a control for non-specific protein effect.

The extracts were given subcutaneously on the side opposite the tumor. Six daily injections were given weekly in maximum tolerated doses. On the death of the animal, careful autopsies were made, and in the absence of visible tumor tissue, microscopic examinations were made of the fixed tissues.

Methods of preparation of extracts are given and dosages stated. The results are shown by graphs, and the work is summarized as follows:

1. Albino rats inoculated with Flexner-Jobling carcinoma, when treated with suprarenal cortex substance extracts, showed neither a delay in the growth of the tumors nor their

genogram revealed the stomach to be small and well to the left of the median line, with persistent hour-glass deformity but no gastric residue. At operation, the gross appearance was that of a linitis plastica, and a total gastrectomy was done. The pathologic diagnosis was gastric granuloma, probably syphilitic.

Five and a half years after operation the patient was living, and appeared to be in good physical condition, except for a marked anemia—noted after the five-year period—which was controlled by intravenous aqueous liver extract and later desiccated hog stomach. This anemia apparently occurs in all gastrectomized patients who live long enough.

C. G. SUTHERLAND, M.B.(Tor.).

The Roentgenologic Appearance of the Normal and Pathologic Relief of the Esophagus. R. Schatzki. *Röntgenpraxis*, June 15, 1931, III, 529-541.

The roentgenologic examination of the esophagus has been more or less a relief examination, due to the narrow canal and the rapid emptying. Systematic examination of the surface of the esophageal mucosa with a thin layer of contrast medium leads to a better and more minute diagnosis. The barium must be given in a rather thick paste, a better demonstration of the mucosa sometimes being obtained by placing the patient in a horizontal position.

The normal esophagus shows narrow longitudinal folds in its entire course; however, in cachectic individuals these folds might be definitely narrowed. Inflammatory changes are evidenced by a marked widening of the mucosal folds. The demonstration of this pathologic change is important not only in the rather infrequently encountered esophagitis, but more so as complication in diverticula, esophageal hernias, and peptic ulcers of the esophagus. The esophagitis may cause the main clinical symptoms (pain, hemorrhage) and may by its demonstration lead to further search for the primary disease.

A case is described in which the complicating esophagitis, which was demonstrated

roentgenologically, helped in finding a small peptic ulcer of the esophagus. The roentgenologic demonstration of esophageal varicosities is possible, a somewhat thinner barium mixture being advised in these cases. The mucosal examination is of great value for the diagnosis of a carcinoma, its extent, and localization, for the demonstration of ulcerative processes, for the differential diagnosis between benign stricture and malignancy, and especially for early diagnosis of a cancer.

H. W. HEFKE, M.D.

Gastric Hyperacidity (?). Editorial. *Jour. Am. Med. Assn.*, June 27, 1931, XCVI, 2199.

Textbooks of to-day tend to identify hyperacidity with hypersecretion, admitting that it is brought about not by concentration of the gastric juice but by production of a larger volume of fluid. Hyperacidity, or hyperchlorhydria, thus becomes identical with hypersecretion after ingestion of food. It might be assumed that "pure" gastric juice could readily be obtained by the use of a stomach tube. All such mechanical devices are likely, however, to promote a production of mucus which will combine with the acid and alter the gastric acidity.

Hollander and Cogwill appear to have mastered the difficulties in experimental animals by collecting the secretion from isolated gastric pouches without any irritation or contamination. It is clear from their convincing data that variations in the rate of secretion are not of necessity accompanied by corresponding changes in acidity.

The hypothesis regarding the constant acidity of the secretion of the parietal cells seems now to be dropped from clinical nomenclature.

C. G. SUTHERLAND, M.B.(Tor.).

Routine Radiograms for Investigation of Intestinal Obstruction. E. T. C. Milligan and George Simon. *British Med. Jour.*, June 27, 1931, No. 3677, p. 1114.

Localization of the site of intestinal obstruction for its relief before operation facilitates

the crater of a gastric ulcer is familiar. Symptoms of gastric ulcer will persist after the ulcer niche has disappeared, so long as there is any mucosal change. The present technic, however, fails to demonstrate an acute hemorrhagic ulcer, as there is no swollen mucosal wall around these lesions. Early neoplasms of the stomach are to be suspected when there is a persistent transverse fold in the normally longitudinally arranged folds of the antrum, or when there is a sudden breaking off of a fold, but these appearances must be persistent.

The actual lesion in duodenal ulcer can be demonstrated by the thickness and swelling of the mucosa. In the large intestine Fischer's method of introducing into the bowel a small amount of barium mixture followed by cautious filling with air facilitates the diagnosis of diverticula, polypoid degeneration, and spastic and organic stricture. In conditions such as colitis, dysentery, and spastic colon, the fine mucous membrane network is replaced by an irregular granular appearance, or the folds may show abnormal prominence.

Excellent photographs exemplifying most of the above appearances accompany the text, but to the technic the author adds nothing new.

J. G. STEPHENS, M.D.

Hyperplastic Gastritis. G. A. Weltz. *Röntgenpraxis*, July 1, 1931, III, 577-580.

The pathologic-anatomical picture as well as the clinical picture of gastritis is very variable. Many questions about the etiology, symptomatology, and clinical findings are still unsettled. According to Konjetzny, the gastritis is the most important factor in the genesis of ulcers. A case with a very extensive hyperplastic gastritis is described.

For about fifteen years, the patient, 53 years old, complained of gastric symptoms consisting of epigastric pain after meals, vomiting occasionally, and loss of weight and strength. Roentgenologic examination showed an absence of normal mucosa; in its place thick and wide folds were seen, especially in the antrum and on the greater curvature side. The ex-

tent of the changes is greater than in any case published, as the author states. The hyperplastic type has remained about the same during two years.

H. W. HEFKE, M.D.

Clinical Study of a Case of Gastric Tumor by Combined Method of Abdominal Palpation and Gastric Sound. Arturo J. Heidenreich and Guillermo L. Heidenreich. *Prensa Med. Argentina*, June 20, 1931, XVIII, 79-86.

The case here presented gives a clinical history which must be divided into two parts, the first part consisting of a typical history of gastric ulcer of ten years' duration, and the second of an abdominal tumor of three months' duration. The symptoms of the latter were, briefly, rapid loss of weight, pain in the epigastrium, which was augmented by food, and the presence of a mass in the upper abdomen at the midline. For diagnosis, a gastric sound was passed, and it was found that both the mass and the sound were felt moving synchronously in the same direction on respiration, change of position, or on pressure.

The other clinical findings pointed toward a gastric tumor and also another tumor, probably at the head of the pancreas. A radiograph confirmed the presence of a double tumor, the first at the pylorus, and the second at the head of the pancreas. As the operation was performed under local anesthesia, it was possible to see, when the patient was asked to take a deep breath, that the tumor moved with respiration, just as palpated before operation. The tumor was found to arise from the posterior wall of the stomach and to invade the head of the pancreas.

N. G. GONZALEZ, M.D.

Chronic Syphilitic (?) Gastritis with Total Gastrectomy and Pernicious Anemia. Allan K. Poole and Lewis C. Foster. *Jour. Am. Med. Assn.*, June 27, 1931, XCVI, 2187-2190.

This is a case report of a patient showing marked emaciation and dehydration. A roent-

breath, thus confirming the recent observation of Thompson and Bumpus.

This modified tray is inexpensive and, with only a slight alteration, is adaptable to most of the standard Bucky diaphragms now on the market.

Several illustrations accompany the paper.

DAVIS H. PARDOLL, M.D.

Partial Resection for Unilateral Reduplication of Pelvis and Ureter. Samuel Lubash. *Am. Jour. Surg.*, July, 1931, XIII, 91-95.

A case of reduplication of the ureter which fused just above the bladder is reported. Pyeloureterography revealed the ureter from the upper segment crossing the ureter from the lower segment at its pelvic junction and causing intermittent hydronephrosis with its accompanying sequelæ. Resection of the upper segment was performed, with marked success and restoration of function in the lower obstructed segment, as evidenced by subsequent pyelography on the resected kidney.

DAVIS H. PARDOLL, M.D.

Diverticulum of the Ureter: A Report of Three Cases. Henry G. Bugbee. *Jour. Urol.*, August, 1931, XXVI, 215-227.

A review of the literature on the subject reveals the fact that diverticulum of the ureter is a rare clinical and anatomic finding. It has been produced experimentally. In four instances, the lesion has been found at autopsy, and seven clinical cases have been reported, to which the writer adds three more.

Pain on the side of the lesion is a predominant symptom. Also, frequency of urination and dysuria were noted in nine of the cases. hematuria occurring in one instance.

Etiology is either congenital or acquired. A congenitally narrow ureteral meatus or an attempt at reduplication of the ureter may produce this condition. When acquired, the origin may be traced to some form of obstruction to urinary excretion, with subsequent dilatation and outpouchings of the ureteral wall.

With the advent of intravenous urography,

it is possible that diverticula of the ureter will be discovered more frequently. Soft, pliable catheters are liable to encounter a diverticulum by being obstructed in their passage, or to demonstrate its presence by coiling up in the diverticulum. The diagnosis may be verified by a ureterogram.

Several illustrations accompany the article.

DAVIS H. PARDOLL, M.D.

Renal and Ureteral Calculi: Some Present-day Surgical Problems. H. G. Hamer. *Am. Jour. Surg.*, July, 1931, XIII, 96-107.

The paper may be summarized as follows: Delayed passage of small ureteral calculi may often be facilitated by ureteral instrumentation, either with the ureteral catheter or bougie or specially devised instruments. Such manipulations are not wholly without danger.

The migrating ureteral calculus is always a cause for worry, being capable of seriously frustrating efforts for its removal.

Calculi of unusual size lodged in the lower ureter frequently require operative removal, either by ureterolithotomy or ureteral meatotomy. Ureteral meatotomy by surgical diathermy is preferable to that by incision.

All urologists recognize that bilateral renal calculi usually manifest a state of advanced renal infection, seldom of the same duration in the two kidneys, hence an unequal degree of renal impairment, and present problems that demand the exercise of trained judgment in the adoption of a program of surgical interference.

Calculus in the solitary kidney is cause for apprehension, the risk of operation being dependent upon the function and the degree of infection.

The combination of stone and renal tuberculosis is rare, and it may be inferred that in such instances the stone is the primary lesion.

Difficulty of diagnosis of renal and ureteral stones by X-ray is most common when the stones are very small, and especially when composed of uric acid. Cystine stones are sometimes transparent to X-ray. The urogram will often make visible a stone transpar

the surgeon's task, and so is of incalculable advantage to the patient. Opaque meal and enema given for X-ray investigations in these cases are, however, too great a source of peril to be practicable, and we must look to some other method.

The authors have found that invaluable information in cases of intestinal obstruction, paralytic and organic, in the small or large gut, is obtained by a routine simple radiogram of the distended abdomen before operation, without the aid of opaque substances (barium enema or meal) and without preparation of any kind. Imprisoned gases outline with striking definition the position, size, and extent of the distended bowel on an X-ray film, the distended large gut being readily distinguished from the small intestine. The gas-filled cecum stands out prominently and characteristically. The site of obstruction in the large bowel is marked by an abrupt ending of the gas-distended bowel. The contracted bowel, empty of gas, below the obstruction, is not apparent on the film, thus lending striking definition to the place of obstruction.

In the X-ray technic, the Potter-Bucky diaphragm is essential, and very gentle compression helps to steady the parts. A soft ray, produced by not more than 75 K.V.P., will bring out the translucent gas areas to the best advantage, while a sufficient milliamperage should be used to enable the exposure to be made in less than four seconds, as the patient is usually too ill to hold his breath any longer.

Six illustrative radiograms are reproduced.

W. D. MACKENZIE, M.D.

GENITO-URINARY TRACT (DIAGNOSIS)

Reflux Pelvic Lavage. Seymour F. Wilhelm. *Jour. Urol.*, August, 1931, XXVI, 247-251.

A case of post-partum bilateral pyoureter (ureterectasia) and pyonephrosis with high blood nitrogen figures was treated daily by reflux pelvic lavage with gratifying results. Re-

flux pelvic lavage is a simple therapeutic procedure, applicable to cases of pyoureter and pyonephrosis where reflux can be demonstrated by cystographic examination. Illustrative pyelocysto-ureterograms accompany the article.

DAVIS H. PARDOLL, M.D.

A Simple Device for Serial Pyeloureterograms. Thomas D. Moore. *Jour. Urol.*, August, 1931, XXVI, 317-323.

The many advantages of serial pyeloureterograms are well known; their importance has recently been emphasized by Jarre and Cumming. They not only reveal the physiologic variations in the contour of the calices, pelvis, and ureter, but may afford an accurate determination of the emptying time of the kidney and ureter. The method of pyeloscopy, as employed by Legueu, is impractical in persons of more than average weight; furthermore, visualization of the detail of such structures as the ureter and minor calices is often inadequate.

The author has constructed a modification of the usual Bucky diaphragm tray, with which three pyelograms may be made in rapid sequence on a standard size film. The details of this method are described in the writer's article.

With this apparatus, it is possible to obtain three well-filled pyeloureterograms within the space of a few seconds. A minimum of time is lost in springing the Bucky and pulling the cassette to a new position by means of a special handle.

A more accurate spacing of exposures for visualization of the emptying time of the kidney is permitted by this device. If two cassettes are used, six pyelograms may be obtained on two standard size films.

The first pyeloureterogram is made after a complete exhalation, the second at the end of inspiration, and the third at the end of a second exhalation. In this way, the respiratory excursion of the kidney is revealed. By this method, also, physiologic kinks in the upper ureter are often observed following a deep

of the kidney pelvis with a ureteral kink, or narrowing of the upper ureter; (g) a V-shaped retraction of the ureteral orifice as seen through the examining cystoscope may be a help in the diagnosis. This change suggests tension on the ureter with retraction of the orifice. A palpable, soft kidney tumor is demonstrable in most cases.

Having shown a ureteral obstruction, the question arises, Is it intra-ureteral in origin or extra-ureteral? A pyeloureterogram will often differentiate between the two forms of obstruction.

The treatment of hydronephrosis associated with anomalous vessels is in most cases surgical. Conservative surgery is indicated early enough before irreparable renal damage has occurred. Re-establishment of free urinary drainage with freeing of adhesions, divisions of bands, nephropexy, and other plastic procedures may be necessary in order to restore proper function.

DAVIS H. PARDOLL, M.D.

Possible Errors in the Interpretation of Intravenous Urography. Davis H. Pardoll and R. A. Lifvendahl. *Illinois Med. Jour.*, July, 1931, LX, 74-76.

Further evaluation and observation are essential in order to attain a greater degree of accuracy in the interpretation of intravenous urographs.

The authors report a case in which uroselectan, intravenously, failed to demonstrate either function or anatomical outline in a kidney which was found on operation to be perfectly normal. This case definitely demonstrates that the absence of visualization does not necessarily imply a pathologic kidney, reflex inhibition, or the absence of a kidney. The patient had a papillary carcinoma of the bladder, which was shown by the cystogram after uroselectan.

The authors, not seeking to detract from the value of intravenous urography, recognize its great value as a diagnostic agent, but call at-

tention to the possibility of erroneous interpretations.

CHARLES H. DEWITT, M.D.

GENITO-URINARY TRACT (THERAPY)

Post-operative Care of Urologic Cases. Henry G. Bugbee. *Am. Jour. Surg.*, July, 1931, XIII, 15-28.

The successful handling of a urologic surgical case is directly dependent upon an accurate diagnosis, thorough preparation of the patient for operation, a well conceived and executed operative technic, and intelligent post-operative care.

Cystoscopy, X-rays, urography, and intravenous urography have aided us materially in our accuracy of diagnosis.

The operative technic should aim towards elimination of pathology and restoration of function. Free drainage, forced elimination, control of hemorrhage, and stabilization of circulation should be sought after in our post-operative case.

Urologic surgical cases most commonly encountered may be grouped as follows: (1) Cases of prostate obstruction; (2) lithiasis; (3) tuberculosis, and (4) malignancy.

In the first group, the writer emphasizes the importance of pre-operative preparation, on which too much stress cannot be laid. Preliminary cystotomy and vas ligation help considerably in the successful management of the subsequent prostatectomy. Post-operative complications and treatment are taken into careful consideration.

One should check frequently with the use of X-rays all cases of urinary lithiasis. Emphasis is laid upon removal of all obstruction, elimination of infection, both local and focal, conservatism of modern surgical measures, with restoration of function wherever possible. Diet and medication in these cases are also of importance.

Tuberculosis of the genito-urinary tract is generally conceded to be secondary to a tuberculous focus elsewhere in the body. Both

ent to unaided X-ray. The "staining" quality of certain media, such as sodium bromide, sodium iodide, uroselectan, and skiadan, has been found helpful.

Extrarenal shadows may usually be differentiated by the lateral X-ray and pyelogram and stereoscopy.

Six interesting cases are reported in detail.

DAVIS H. PARDOLL, M.D.

Inflammatory Obstruction of the Ureter, Caused by Psoas Abscess, Secondary to Tuberculosis of the Spine. Gilbert J. Thomas and Thomas J. Kinsella. *Am. Jour. Surg.*, July, 1931, XIII, 72-74.

The authors report two cases of ureteral obstruction due to psoas abscess. Hydronephrosis and destruction of the kidney resulted from the constriction of the ureter. This condition was not associated with tuberculosis of the kidney. The urinary findings were negative. Also, the history was of no value in enabling one to arrive at a diagnosis of ureteral obstruction.

The possibility of obstruction of the ureter in all cases of psoas abscess should be considered.

DAVIS H. PARDOLL, M.D.

Pyeloscopy: A Diagnostic Procedure which Promises to Inaugurate a New Era in the Recognition and Satisfactory Treatment of Painful Abnormal Motility Syndromes of the Upper Urinary Tract. William P. Herbst. *Jour. Urol.*, August, 1931, XXVI, 233-239.

Pyeloscopy preliminary to pyeloureterography will eliminate re-cystoscopy for patients who have been unfortunate enough to have unsatisfactory urograms as a result of filling technic difficulties. Manges was the first one to suggest the use of pyeloscopy, in 1918. He had employed this method of examination since 1912.

The action of atropin, eserine, morphine, strychnine, pituitrin, and ergot on the motility of the upper urinary tract, as observed by pyeloscopy, is a distinct contribution to the pharmacologic action of drugs.

There are definite renal, pain-producing, abnormal motility syndromes which can be recognized by pyeloscopy and satisfactorily relieved by eserine or sympathectomy.

The complete cycle of urinary expulsion from the minor calices to the bladder is illustrated graphically as observed by pyeloscopy.

Further observation, together with the assimilation of medical and surgical data, promises a new era of success in the treatment of renal pain syndromes which have heretofore been the source of much grief to both patient and doctor.

DAVIS H. PARDOLL, M.D.

Prostatic Stone Causing Pseudodiverticulum of the Posterior Urethra. J. S. Eisenstaedt and T. G. McDougall. *Jour. Urol.*, June, 1931, XXV, 639-648.

A prostatic stone, which by increase in size produced a pseudodiverticulum of the urethra, is reported. Stones of this type have been described as urethral diverticular stones, which is misleading. True prostatic stones are always multiple and have as a nucleus organic material which is the corpora amylacea. The etiology of prostatic calculi is not well understood, but they are often associated with other genito-urinary pathology. The X-ray is the most important diagnostic aid. Treatment by perineal prostatotomy is the method of choice, even when the stone communicates with the urethra.

DAVIS H. PARDOLL, M.D.

Aberrant Renal Vessels in Children. George M. Fister and Eugene H. Smith. *Jour. Urol.*, August, 1931, XXVI, 175-187.

Although accessory renal vessels are common and ureteral obstruction is present in 2 per cent of all children, the association of the two is uncommon.

The following symptoms make the diagnosis of aberrant renal vessels probable: (a) Repeated attacks of pyelitis; (b) no calculi; (c) intermittent attacks of renal colic; (d) ureters normally catheterized; (e) micturition normal; (f) pyelographic evidence of dilation

F. W. Bishop emphasized the importance of maintaining an efficient cardiovascular system and proper intestinal elimination.

N. P. Rathbun discussed post-operative hemorrhage; preliminary ligation of the vas, as a preventative of epididymitis, and toxic psychosis. In carcinoma of the prostate, he advocates suprapubic cystotomy. He also employs radium, either through the bladder or through the perineum.

Oswald S. Lowsley made a few interesting remarks relative to urinary lithiasis. By changing the reaction of the urine to acid from alkaline and keeping it changed, no recurrence of lithiasis occurred in a patient who previously had had several remissions of this condition.

This is a very interesting paper and should be read by all interested in these urologic problems, the discussions by some of the eminent leaders in this field being particularly worthy of consideration.

DAVIS H. PARDOLL, M.D.

Hydronephrosis with Aberrant Polar Vessels: Report of a Case. Horatio N. Dorfman. *Jour. Urol.*, July, 1931, XXVI, 121-130.

The author presents a case of hydronephrosis, due to aberrant vessels. At operation these anomalous renal vessels were ligated and nephropexy performed. The pain was relieved and the position of the kidney somewhat improved, with a slight reduction in the capacity of the renal pelvis. The function was increased to equal that of the unaffected side, while the infection which had been present was cleared up, as demonstrated by two subsequent sterile cultures.

DAVIS H. PARDOLL, M.D.

GYNECOLOGY AND OBSTETRICS

Pruritus of the Vulva. Juan Luis Sardi. *Rev. Méd. Cubana*, August, 1931, XLII, 956-970.

The writer introduces in this article a good outline of the different types of pruritus of the vulva, paying particular attention to the diag-

nosis, since that is essential for adequate treatment. He goes into detail concerning each type. In outlining the treatment, he considers weak radio-active substances. Bayet has obtained very good results with Becquerel's rays. In Vienna, they report excellent results from beta rays. The author has used forik-erine in the form of a salve, applied locally, on 12 cases, obtaining a permanent cure in 10, improvement in one, and no change in the other. His best results have been on pruritus of diabetic origin. He has not used X-rays or radium but reviews the literature and concludes that the results appear to be very good. He refers to the Breslau Clinic statement that X-rays constitute the elective treatment in such cases and reports 60 per cent cure and 100 per cent improvement.

N. G. GONZALEZ, M.D.

Factors in and Causes of Fetal, Newly Born, and Maternal Morbidity and Mortality. Hugo Ehrenfest. *Am. Jour. Obst. and Gynec.*, June, 1931, XXI, 867-880.

This is a comprehensive report. Only the portions of interest to radiologists will be abstracted.

Cancer is one of the rarer complications in pregnancy. If in a state in which cure seems possible, the disease should be treated without any consideration of the pregnancy. When the malignancy is advanced, treatment must be given with the thought of saving the child. A patient seemingly cured of a malignant disease should not be permitted to go through a pregnancy.

The author states that many women suffering from myeloid leukemia have been known to pass through two and even more labors. Interruption cannot be expected to prove useful, since any operation on a leukemic patient admittedly implies considerable risks. These women should be warned against becoming pregnant, but if they do conceive, it is probably better to let the pregnancy go to a termination.

The author states that it has been demonstrated beyond all reasonable doubt that pre-conceptional irradiation is harmless as far as

pre-operative and post-operative care consist of general hygiene and tonic measures to increase the patient's resistance and lessen the activity of the acute lesion. Observation is continued for an indefinite period after the operation the better to detect any residuum of the infection.

The post-operative care of malignancy may be summed up in the words "eternal vigilance." Whether the operation be a radical removal of the tumor, if fortunately diagnosed at an early stage, or whether the growth be treated by radium, diathermy, or deep radiation, in an attempt to destroy or control it, the future of the case depends upon regularly repeated observations. Only by such post-operative care can the various methods of treating malignancy be evaluated. Post-operatively, the X-ray may be employed to demonstrate the position and number of radium seeds. In conjunction with other urologic examinations, the progress of the case may be observed. Further radium treatment may not be indicated by these procedures. In this manner, much may be accomplished. Early recurrences may be detected cystoscopically. These respond more favorably and more rapidly to fulguration than do the primary growths, especially after radiation, and they may often be eradicated if discovered in their incipency. Here deep radiotherapy and radium are valuable adjuncts, often advantageously applied together. Results will be in direct proportion to the time at which the growths are detected and treated.

Cases of bladder tumor should return for observation every month after operation. Later, not more than six months should elapse before re-examination, for a period of five years.

Renal tumor patients should be examined regularly for the presence of metastases or recurrences. Deep radiotherapy of the kidney region may be beneficial in inhibiting local recurrence.

In all cases of tumor of the testicle, deep radiotherapy should be applied to the wound region, inguinal, and renal regions, after the removal of the growth. Some observers advise radiotherapy before as well as after operation.

The intimate connection of surgical lesions of the urinary tract with the remainder of the body, such as prostatic obstruction with kidney function and the circulatory system; tuberculosis with tuberculous lesions in other parts of the body; lithiasis with the various body functions and focal infections, and malignancy with metastases, render a study of the whole body imperative, and a proper restoration of function and health, with a maintenance of the same dependent upon a carry-through. This means the utilization of every means of post-operative treatment and continued observation over long periods of time, with the employment of suitable measures at a time when recurrences of pathology are detected in their incipency and may be eradicated.

In no other class of cases is this follow-through of more importance, and the urologist holds no claim to results until the patient has been placed upon his feet, free from complications, and has passed the probable period of relapses and recurrences.

The discussions which followed Bugbee's paper were exceedingly interesting. Most of the doctors were in accord with his résumé of the proper pre-operative preparation, surgical technic, and post-operative care. There were, however, a few problems in which some of the speakers propounded their own viewpoints and experiences.

B. S. Barringer laid stress upon carcinomatous conditions of the prostate and bladder. He is an ardent advocate of radium, radium emanation, and roentgenotherapy in these cases.

Edwin Beer stated that in the study of X-ray treatment of tumors, whether they be primary tumors or recurrences, whether they be renal or bladder, he had failed to see any results. He advocates radical extensive surgery wherever possible in tumors of the upper genito-urinary tract. In carcinoma of the prostate, X-ray occasionally seems to benefit some patients, though the evidence is not absolutely clear. In connection with tumor of the testicle, the results seem to be in favor of X-ray treatment of the original tumor prior to operation.

cases of multiple hemangioma have been reported. The angiomas may be situated in the pelvis, medulla or cortex, though seldom seen in the latter. The lesion is composed of large cavernous sinuses, lined with endothelium and filled with blood. Injury and ulceration play a part in the onset of hemorrhage, the only constant clinical symptom. The diagnosis is seldom correctly made, and nephrectomy, so far, is the only satisfactory method of treatment.

Jacobs and Rosenberg, and also Jenkins and Drennan, claim that after examination of the pyelograms, in their respective cases, a certain mottled appearance, due to the entrance of pyelographic fluid in the angiomatous spaces, would be sufficient grounds for a diagnosis. The great difficulty in this interpretation would be the deformity caused by the retention of blood-clot in the pelvis. Neoplasm should be kept in mind.

DAVIS H. PARDOLL, M.D.

Two Unusual Cases of Perinephritic Abscess. John A. Taylor. *Am. Jour. Surg.*, July, 1931, XIII, 11-14.

Bilateral perinephritic abscess, although a comparatively rare disease, is probably not as uncommon as one is led to believe by a review of the literature. Hunt, in 1924, reported only one in 106 cases of perinephritic abscess seen at the Mayo Clinic in ten years, and could find only nine cases in the literature at that time. Yet several unpublished cases were mentioned in the discussion which followed the reading of his paper.

This case is presented, not so much as an oddity as an illustration of how persistently the opposite side should be examined for suppurative perinephritis when the clinical course of a post-operative perinephritic abscess case is not satisfactory, because the diagnosis is often very difficult before the X-ray shows signs of a well-developed abscess.

The author reports a case of a metastatic perinephritic abscess which continued to run a temperature following incision and drainage on the right side. The cause of this rise in temperature was found to be a similar condition

on the left side, which was treated accordingly and was followed by recovery.

A second case was that of a perinephritic abscess in a child which, following operative interference, developed a urinary fistula communicating with the pelvis of the kidney. A plastic was done, with complete recovery.

In the discussion by Edwin Beer, the cortical nature of these lesions is stressed, although it is conceivable that some cases start in the perinephritic fat. Also, one should not fail to suspect the opposite kidney in cases of renal infection which continue to run a temperature following operation. The earlier one operates the better the prognosis and the greater the chance of saving the kidney.

In his twenty-odd years of experience, Beer has seen only three cases of bilateral perinephritic abscess. The exciting organism is usually *Staphylococcus aureus*.

As far as X-ray diagnosis is concerned, although not present in all cases, obliteration of the psoas muscle and curvature of the spine to the opposite side have proved of aid as confirmatory physical signs. Frequently the X-ray films reveal this condition even before the physician suspects it. Beer cites such a case which followed a nephrectomy, due to infection from the spine. Aspiration for diagnosis with a needle is a dangerous procedure and should be avoided.

DAVIS H. PARDOLL, M.D.

Spontaneous Rupture of a Kidney, Due to an Encysted Calculus: Report of a Case. Earl Floyd and J. L. Pittman. *Jour. Am. Med. Assn.*, July 11, 1931, XCVII, 98.

This is a report of a case of rupture of the kidney at the site of a stone, present for at least four years, in the lower pole. Slight trauma over a long period of time brought about a tear in the kidney at that point, resulting in a hemorrhage into the perinephric tissue. This was subsequently followed by an infection, with accumulation of pus, which burrowed around the kidney and down along the psoas muscle. Following operation, the kidney became practically normal.

In all cases of spontaneous rupture of the

the future child is concerned. In contrast, post-conceptional application of radium or X-ray to the pelvic region in larger doses for therapeutic purposes implies a great risk of damage, especially of the fetal central nervous system. Such treatment should always be preceded by curettage.

Short exposure for roentgenograms during pregnancy most probably is entirely free of any harmful effect on the fetus, granted that this procedure is not too often repeated, especially in early pregnancy.

JACOB H. VASTINE, M.D.

Primary Face Presentation. U. Fernández and F. Tallaferro. *Semana Méd.*, May 14, 1931, XXXVII, 1323-1329.

The authors present this case because the existence of such a condition is so rare that it is doubted by many obstetricians. A woman was examined fourteen days before she went into labor. The obstetrician made the diagnosis of face presentation and called two other physicians on consultation, who made the same diagnosis. To confirm their findings, they took two radiographs several days apart and both of them showed a face presentation. The patient was examined daily for fourteen days until she went into labor, and there was no change of position found at any time. During labor and delivery, the presentation was found to be face.

N. G. GONZALEZ, M.D.

HEART AND VASCULAR SYSTEM (DIAGNOSIS)

Enlarged Hearts. Gastón Giraud. *Semana Méd.*, June 5, 1930, XXXVII, 1456-1463.

In this article, the author treats of enlargement of the heart and goes into detail concerning its diagnosis. In doing so, he discusses the great help obtained from radiology, particularly orthoradiology, which projects on the screen, and teloradiology which prints on a film the heart in its true relations. On de-

scribing the different conditions, he considers their diagnosis from the radiologic point of view.

N. G. GONZALEZ, M.D.

Visualization of Diseases of Peripheral Arteries. V. Kollert. *Wien. klin. Wchnschr.*, 1930, I, 344. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 271.

There are definite indications for arteriography, and the chief of these is a vascular obstructive process. The author discusses the diagnostic and therapeutic values of the method. Of interest are the variations of the capillary bed which are noted after injection of uroselectan.

H. C. OCHSNER, M.D.

Arteriography. M. Sgalitzer. *Wien. klin. Wchnschr.*, 1930, I, 343. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 271.

The author discusses the roentgenologic demonstrable changes in thrombosis, embolism, endarteritis, arteriosclerosis, and spasm. He uses uroselectan in about one-tenth the quantity necessary for intravenous pyelography. There are numerous illustrations, and the author discusses the diagnostic possibilities of the method.

H. C. OCHSNER, M.D.

THE KIDNEY

Hemangioma of the Kidney: A Report of Two Cases and a Brief Résumé of the Literature. David W. MacKenzie and Allan B. Hawthorne. *Jour. Urol.*, August, 1931, XXVI, 205-214.

The authors submit a brief résumé of the literature and report two cases of their own. They find hemangioma of the kidney to be a rare condition. It is usually single, though

therapy in Mikulicz' disease. The author reports six cases, in one of which therapy was of no avail, in four a cure was accomplished, and in one a recurrence took place after four years. The salivary and lacrimal glands were irradiated at six-week intervals, giving 390 r. with heavy filtration, at each treatment. Roentgenotherapy is the method of choice in the treatment of this disease.

H. C. OCHSNER, M.D.

RADIATION THERAPY

Roentgen Therapy of Agranulocytosis. U. Friedemann and A. Elkeles. *Deutsch. med. Wchnschr.*, 1930, I, 947-950. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Dec. 12, 1930, IX, 616.

The authors irradiated the long bones, using 1/20 H.E.D. of highly filtered rays. Of forty-three cases of agranulocytosis, eighteen were complicated by sepsis and five by pneumonia. These all died despite treatment. Of fifteen uncomplicated cases thirteen were cured. The effect of irradiation was noted within twenty-four hours, in the favorable cases.

H. C. OCHSNER, M.D.

Factors Concerned in Radiation Therapy of Malignant Disease. L. R. Sante. *Illinois Med. Jour.*, July, 1931, LX, 82-84.

The factors discussed by the author are as follows: (1) The location and size of the growth; (2) the degree of radiosensitiveness of the tumor cells, and (3) the environment of the tumor cells as to whether or not the growth is dependent upon the blood supply for its nutrition or whether it gets a supply also from the lymph, as in metastatic growths in lymph nodes.

The author mentions three types of reaction of tumor cells to radiation: Autolytic, necrotic, and growth-restraining. He concludes as follows:

"Never consider any malignant growth, no matter how small it may be or how slight the

involvement may seem, to be insignificant, and conversely, never consider any malignant growth, no matter how large or extensive it may seem, to be hopeless until it has been given the 'test of irradiation.'"

CHARLES H. DEWITT, M.D.

Hypertrichosis Following Parotitis; Roentgen Therapy. E. Lesné, Germaine Dreyfus-Sée, and J.-A. Lièvre. *Bull. Soc. Pédiatr. Paris*, 1930, XXVIII, 94-110. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Dec. 12, 1930, IX, 617.

A seven-year-old girl developed an endocrine symptom complex over a period of three years, following a bilateral parotitis. There was cessation of growth, adiposity, marked hypertrichosis, and onset of menstruation at nine. Following irradiation of the adrenal region, the hypertrichosis promptly disappeared.

H. C. OCHSNER, M.D.

Roentgen Treatment of Root Pains. J. Laborderie. *Rev. d' Actinol.*, May-June, 1930, VI, 221-236. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Dec. 12, 1930, IX, 617.

Roentgen therapy gives relief in a large percentage of cases after all other methods have failed. The mechanism is an attack on the inflammatory infiltration about the nerve, analogous to the surgical liberation of the nerve caught in scar tissue.

H. C. OCHSNER, M.D.

Radiotherapy in Infantile Poliomyelitis. Louis Delherm and Pierre Mathieu. *Rev. d'Actinol.*, 1929, V, 683-690. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 280.

The roentgen therapy of poliomyelitis as suggested by Bordier should be used early and systematically. The results are satisfactory, although they do not differ particularly from

kidney reported, there was evidence of disease. Many causes are listed as bringing about this condition, such as tuberculosis, acute focal infections, stones, infarcts, polycystic and solitary kidneys.

C. G. SUTHERLAND, M.D.

Some Interesting Cases of Diagnosis of Kidney Diseases. Thomas Canigiani. *Röntgenpraxis*, July 15, 1931, III, 642-648.

The author reports cases with diagnostic problems involving diseases of the kidneys.

The first case was that of a 62-year-old man with complete retention, hematuria, prostatic hypertrophy, and a diverticulum of the bladder. Cystoscopy showed a decreased excretion of dye from the right ureter. An intravenous pyelogram revealed a poorly functioning right kidney with a filling defect in the lower half. A retrograde pyelography gave the same finding. At operation a carcinoma of the right kidney was found.

The second case was of interest on account of a stone in the pelvis of the left kidney, situated very low in front of the os sacrum. On a flat film the shadow was thought to be a stone in the left ureter. An intravenous pyelogram showed it to be contained in the pelvis of a congenital pelvic kidney.

The third case showed bilateral dystopic kidneys, both being in the pelvis, with a large branched stone on the right. An intravenous pyelogram revealed a hydronephrosis on the right side. A flat film had not been made before, and stones in both kidney pelvis were not seen. It is evident that a flat film should always be made before a pyelogram is done.

H. W. HEFKE, M.D.

MEASUREMENT OF RADIATION

X-ray Wave Length Change by Partial Absorption. J. M. Cork. *Phys. Rev.*, June 15, 1931, XXXVII, 1555. (Reprinted by permission.)

The attempt to repeat the experiments of Mr. B. B. Ray in which a change in wave length occurred in an X-ray beam upon

passage through an absorbing substance, has been continued. In the previously reported experiments CuK -radiation was passed through absorbers of boron, beryllium, carbon, nitrogen, and oxygen. These same absorbers have been retried with tungsten L -radiation with a spectrometer of greater dispersion. Although it should have been possible to observe a modified line of $1/3000$ the intensity of the unmodified, in no case has any trace of a modified line been observed.

The Absorption Law of Short Wave Gamma Rays. Lise Meitner and H. H. Hupfeld. *Ztschr. f. Physik*, 1931, LXVII, 147-168.

By means of a Geiger-Müller tube counter, the authors made a series of absorption measurements of various substances by a well-defined bundle of gamma rays. This bundle was obtained by placing the radium preparation in a large block of iron ($69 \times 50 \times 42$ cm.) which had a fine opening on one side. Four millimeters of lead were used as a ground filter, and it was possible with this arrangement to isolate a homogeneous wave length 4.7 X-E. from thorium C" and an average wave length of 6.7 X-E. from radium C. The weakening effect in using these short wave lengths is due only to scattering, and the measurements, therefore, make it possible to determine the coefficient of scattering. In comparing the values thus obtained with those gained with Klein and Nishina's theoretical formula, it was found that the results agreed only for elements of a low atomic number. For elements with a high atomic number, the scattering was found to be larger than indicated by the formula.

OTTO GLASSER, Ph.D.

MIKULICZ' DISEASE (THERAPY)

Use of Roentgen Therapy in Mikulicz' Disease. István Farkas. *Magy. Röntgen Közl.*, IV, 143-147, and *Deutsch. Zusammenfassung*, 1930, pp. 150, 151. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Dec. 12, 1930, IX, 616.

Fittig was the first (1904) to use roentgeno-

The author discusses, in a clear and concise manner, such subjects as the X-ray tube, the physical properties of the X-ray, the discovery, sources, and measurement of radium, the nature of radio-activity, the preparation of radon, the types of radium rays, the transmission of rays through the tissues, the filtration of radium, and the biophysics of X-rays and radium.

The author demonstrates that therapy applied by the use of X-rays and radium has a strictly scientific basis. He closes with this outlook: "The future of radiotherapy in the field of medicine rests entirely upon the basis of a greater knowledge of the physical properties of radio-activity and a correlation of these with the biological effects."

L. J. CARTER, M.D.

Medical Uses of Radium. Special Report, Medical Research Council, No. 150, Bull. Hyg., 1930, VI, 380.

An account is given of the research on Radium therapy in 1929. The current technic used in the various laboratories is described, as well as the effect on the various types of cells. The time of exposure if regulated may produce beneficial results, while unregulated exposure may aid the disease by the destruction of the cells, as is found in the variation in the action of many drugs when the dose is varied.

CHEMICAL ABSTRACTS.

THE SINUSES (THERAPY)

Treatment of Hay Fever by Intranasal Zinc Ionization. Philip Franklin. British Med. Jour., June 27, 1931, No. 3677, p. 1115.

The problem of hay fever has of recent years been studied from many angles. Specific and non-specific desensitization has yielded only moderate results. The following technic is placed on record because of the uniformly successful cures obtained by intranasal zinc ionization.

The intranasal mucosa is covered with thin layers of cotton-wool, soaked in a 1 per cent

solution of zinc sulphate in distilled water. Particular care should be taken to cover the middle turbinate and the adjacent septal mucous membrane. A zinc terminal is placed in each nostril and connected with the positive pole of a galvanic battery. The indifferent electrode is applied to the forearm or hand. A current of from three to five milliamperes is passed for from fifteen to twenty minutes.

If the tissues are swollen and irritable, they should be sprayed with a 4 per cent solution of cocaine before applying the wool. The patient experiences a metallic taste and increased salivation, a conjunctival hyperemia, with lacrimation or blushing during the ionizing process, and may have attacks of sneezing during the subsequent twenty-four hours.

One or two treatments at an interval of seven days are required to cure the hay fever for that season. It is generally necessary to repeat the treatment each season.

W. D. MACKENZIE, M.D.

THE SKULL (DIAGNOSIS)

A Probe in the Cranial Cavity for Seventeen Years. J. S. McEachern. Canadian Med. Assn. Jour., May, 1931, XXIV, 692, 693.

On November 17, 1925, a single man, aged 33, presented himself complaining of attacks of "fits."

In October, 1908, he had been shot in the head with a shotgun. There was a great deal of damage to the frontal bone. The right eye was destroyed and had to be enucleated. As a result of the injury, he was ill for 132 days. In February, 1910, he had a "fit." Just before it came on he found that his head rotated to the right. He was unconscious after the "fit" for half an hour. For the next eleven years he had a similar seizure every four or five months. For the four following years he had an attack every three or four weeks.

A radiograph, the reduction of which accompanies the case report, shows the shadow of a probe in the cranial cavity. The eye of the probe lies opposite the scar tissue, filling

those obtained by other methods. The method offers no certainty of cure except in the earliest stages of the disease, and one should, therefore, be extremely careful in offering a prognosis.

H. C. OCHSNER, M.D.

The Histologic Evaluation of the Effect of Radiation on Carcinoma. J. Wätjen. *Deutsche med. Wchnschr.*, April 17, 1931, LVII, 662-664.

The author states that it is very difficult to solve a complicated problem, as the radiobiology of tumors, by histologic investigations alone. If we summarize our present knowledge concerning the histologic changes following the irradiation of neoplasms, we must conclude that the inhibitory effect on the carcinoma cells is most important. The reaction in the surrounding tissue must not be disturbed by too high a dose; severe systemic reactions should also be avoided, since the resistance of the organism, as a whole, has a far-reaching influence on the results of radiation therapy.

ERNST A. POHLE, M.D., Ph.D.

RADIUM

Radium Therapy. Editorial. *British Med. Jour.*, Oct. 18, 1930, No. 3641, p. 651.

This is a report of some of the conclusions reached by the National Radium Trust and the Radium Commission, after their first year's stewardship, and amounts to a guarded and provisional verdict of "Not Proven."

The commissioners insist upon the need for great caution in estimating the value and efficiency of radium in the treatment of cancer, and deprecate in the strongest terms the kindling of false hopes by means of sensational or even optimistic statements.

They conclude that the best that can be said is that some results under certain conditions are very satisfactory; that others, for no clearly established reasons, are less so. The results are either inconclusive or definitely dis-

appointing in a considerable proportion of the cases. This, in their opinion, does not justify a pessimistic outlook, because many problems that yet remain unsolved may yield to experience and research.

In regard to malignant disease generally, the Commission states, as its considered opinion, that while radium "holds out a good promise of beneficial results, and certainly of alleviation of suffering, it is at present a very dangerous weapon, and one which, unless used with the greatest skill, care, and precaution, may easily be productive of more harm than good."

W. D. MACKENZIE, M.D.

The Methods for Testing Radium Preparations Used by the Physical Laboratory of the Radiumhemmet, Stockholm. Rolf M. Sievert. *Acta Radiol.*, 1930, XI, 649-657.

Various methods of testing radium preparations in the Radiumhemmet, Stockholm, are described and illustrated in a number of diagrams. The strength of the preparation is determined by means of a two-electroscope arrangement, which avoids the errors inherent in measuring with only one instrument. The electroscopes are built of zinc. Possible leakage of the radium preparation is detected by bringing the preparation into an evacuated vessel in which air is afterward brought, which, in turn, is then examined for traces of radium emanation. The distribution of the salt within a capsule is examined by a photometric method. All the data of these tests are collected on a calibration card which accompanies each preparation.

OTTO GLASSER, Ph.D.

The Physics and Biophysics of X-rays and Radium. W. H. McGuffin. *Canadian Med. Assn. Jour.*, May, 1931, XXIV, 679-684.

This is the fourth paper in the series being contributed by the members of the Canadian Radiological Society for the education of the general profession along radiological lines.

results. The author believes that the results of this combined method of treatment are better than those obtained by radiotherapy alone. Great importance is attached to the technic of application of the X-rays, which, however, is not detailed in the present account of the communication to the French Society of Electrotherapy and Radiology.

WALTER M. LEVITT, M.B., M.R.C.P., D.M.R.E.

General Considerations on Forty Cases of Scoliosis. Sara Satanowsky. *Semana Méd.*, Jan. 29, 1931, XXXVIII, 305-326.

The author gives herein a very extensive and complete treatise on the different types of scoliosis and their treatment. She presents forty cases which she has treated and shows X-ray film reproductions of the different conditions. The article is of great value to orthopedists.

N. G. GONZALEZ, M.D.

SYPHILIS

The Various Aspects Presented by Syphilis in Dermatologic Practice. José Luis Carrera. *Prensa Med. Argentina*, June 20, 1931, XVIII, 96-100.

The author bases this article on 949 cases of syphilis which he has treated in the last four years. He considers every type of syphilis, except the primary and congenital forms, giving histories of several cases. He presents a radiograph of a gastric ulcer cured with antisyphilitic treatment, which is the only case of this kind that has come under his observation.

N. G. GONZALEZ, M.D.

Studies on Congenital Syphilitic Bone Disturbances Found in Early Childhood. M. Péhu and A. Policard. *Rev. franç. Pédiatr.*, 1929, V, 655-667. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 269.

The designation, syphilitic osteochondritis, is inaccurate inasmuch as the pathologic changes are in bone rather than in cartilage.

The site of changes is the end of the diaphysis just proximal to the epiphyseal margin. As in other syphilitic processes, the chief change is in the vascular system; there is hypervascularization and vasodilation, with resultant atrophy of bone substance. The growth processes are not interfered with, but there is a rarefaction of the bone, with consequent liability to fracture.

H. C. OCHSNER, M.D.

THE THYMUS (DIAGNOSIS)

A Malignant Tumor of the Thymus Gland. W. Cecil Bosanquet and W. Ernest Lloyd. *The Lancet*, July 4, 1931, CCXXI, 6-9.

The authors present the case history of a girl twenty years of age who died in an attack of dyspnea. The patient had been studied, and although a tentative diagnosis of pulmonary tuberculosis had been made, radiographic evidence was not characteristic. At autopsy the thymus was found to be the site of a tumor, and pulmonary metastases were present in the lower part of both lungs, without involvement of the tracheal glands. Histologic study suggested an endothelioma and not a tumor of thymic origin.

The authors review the literature and suggest that many carcinomas of the thymus may have been endothelial in origin because of the similarity in appearance to carcinoma.

The paper is concluded by discussions of symptomatology, diagnosis, treatment, and prognosis of tumors of the thymus gland.

H. J. ULLMANN, M.D.

Roentgen Studies of the Thymus Gland in Children: Diagnosis and Treatment. J. W. Frank. *Jour. Am. Inst. Homeop.*, June, 1931, XXIV, 553-558.

The author discusses the importance of a careful and uniform technic in making roentgenograms of the thymic gland in children. He has followed Wasson's method of making the X-ray exposure in the postero-anterior po-

the bony defect at the lower part of the forehead. The probe passes from this point upward and to the left. The probe was removed through an incision in the scar tissue. The recovery was uneventful. Freedom from "fits" has followed for five years, up until the time of this report.

L. J. CARTER, M.D.

THE SPINE (DIAGNOSIS)

Case Reports of Spondylitis Ankylopoietica. I. Odessky. *Röntgenpraxis*, June 15, 1931, III, 544-550.

Ossification of the connective tissue of the joint ligaments with an ankylosis of the small joints of the spine is the pathologic basis for a spondylitis ankylopoietica (also called Bechterew-Strümpell-P. Marie disease). The vertebral bodies usually show more or less atrophy and decalcification. Hereditary factors, infections, and trauma have been considered as etiologic factors. One case is described in which not only the vertebrae, but also many other joints were attacked, the patient being rigid and rendered entirely an invalid. Such a picture may be called polyarthritis chronica ankylopoietica. Three other cases are described, in which the spine was mainly attacked, but which had only a few symptoms. No therapeutic efforts seem to be of any value.

H. W. HEFKE, M.D.

Spinal-cord Tumor: Two Case Reports. Fred E. Woods and Wendell S. Keate. *Med. Herald, Phys. Ther., and Endocrine Survey*, July, 1931, L, 278-281.

The authors report two cases of spinal cord tumor. The first patient's original complaint was pain in the left chest. Nine months later he developed spastic paralysis in the lower extremities. Physical examination at this time showed multiple fibroma of the skin. The impression derived from X-ray examination of the chest at this time was neoplasm in the left upper lung, probably benign. X-ray films of

the spine and pelvis showed no apparent pathology. Autopsy five months later revealed a post-pleural tumor, diagnosed a neurofibroma, arising from between the first and second thoracic vertebrae, with compression of the cord.

The second patient on admission complained of numbness in the feet and legs, difficulty in walking, and pain in the lower back. An X-ray examination of the spine and pelvis showed no bony changes. Other clinical signs pointed to a spinal cord tumor. The patient died eleven months later, an endothelioma being found at that time. The mass extended through the spinal canal from the level of the seventh dorsal vertebra to the cauda equina.

The authors cite these cases to show the difficulty of diagnosing spinal cord neoplasms.

W. S. PECK, M.D.

A Contribution about Spina Bifida in the Region of the Dorsal Vertebrae, and the Trophoneurosis Connected with It. V. L. Towbin and R. I. Jalin. *Röntgenpraxis*, July 1, 1931, III, 622-624.

Spina bifida in the region of the lower lumbar and sacral spine is not infrequently seen; its occurrence in the dorsal spine, however, is rare. A man, 52 years old, presented a scar-like depression over the fourth dorsal vertebra, over which there was an increase of hair growth. He complained of some pain in that region and in the upper extremities. Roentgenologic examination showed an irregular defect in the arch of the third and fourth thoracic vertebrae corresponding to the picture of spina bifida. The spinous process of the second thoracic vertebra was absent.

H. W. HEFKE, M.D.

THE SPINE (THERAPY)

Bordier's Method in Poliomyelitis. G. Ronneaux. *La Presse Méd.*, March 25, 1931, XXXIX, 439.

This is an account of 15 cases treated by a combination of radiotherapy, diathermy, and galvanism (Bordier's method), with excellent

downward as far as the fourth costal cartilage. The normal weight of the gland varies with the age and weight of the child.

The symptoms usually attributed to enlargement of the thymus gland in infants are cough, dyspnea, cyanosis, and stridor. These result from pressure of the gland on the surrounding structures, such as the trachea and recurrent laryngeal nerve. Examination of these infants reveals substernal dullness and a palpable mass in the suprasternal notch. The value of the X-ray diagnosis of enlarged thymus has been discussed by many writers. The authors believe that correlation of the clinical findings with the X-ray evidence is necessary for a definite diagnosis.

In 100 consecutive new-born infants in the obstetrical wards of the Hahnemann Hospital, in Philadelphia, the thymic shadows were studied within forty-eight hours of birth. If the thymic shadow was found to be enlarged, a second roentgenogram was made on the tenth day after birth. The normal thymic shadow was considered one in which the mediastinal shadow at the level of the second thoracic vertebra was from one and one-third to twice the transverse diameter of this vertebra. Of the 100 new-born infants 62 were found to have enlarged thymic shadows. Sex, primiparity, or multiparity of the mother seemed unimportant factors, but race and birth weight showed a definite relationship to the number of positive roentgenograms, the negro infants and those whose birth weight was in excess of eight pounds showing the highest percentages. Roentgenograms of the 62 positive cases, taken ten days after birth, showed that one-third had an increase in the thymic shadow, one-third a decrease, and the remaining third no marked change. Twenty-four cases showing increased or stationary thymic shadows were again examined roentgenologically at the age of six weeks. Of this number about one-third showed increase, one-third showed decrease, and one-third showed no change. At six months, of six infants showing increase in the thymic shadow, 50 per cent showed decrease, 33 per cent a continued increase, and 17 per cent no change. None of these infants at any time showed di-

rect symptoms indicating the presence of an enlarged thymic gland, nor did any of these cases receive X-ray or radium therapy to reduce the size of the gland.

J. N. ANÉ, M.D.

THE TONSILS

Roentgen Therapy of Tonsils. G. Schulte. *Fortschr. Röntgenstr.*, 1930, XLII, 120-122. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Dec. 12, 1930, IX, 610.

The author treated 257 cases, 132 of which were children varying in age from two to fourteen, and 125 adults. One hundred sixty-nine of the 257 had good results, 12 were improved, 8 unimproved, and 40 unknown. Twenty-eight were still under treatment. Exclusive of the last two groups 90 per cent were cured, 6 per cent improved, and 4 per cent unimproved. The cases were all of the bilateral chronic inflammatory type. The tonsillar region on each side was treated, the tube angling upward.

One-third H.E.D. was given in children, using an F.S.D. 30 cm., 140 K.V., 4 mm. Al. fields 6×8 cm., and $\frac{1}{3}$ H.E.D., with 210 K.V., 1 mm. Cu, plus 1 mm. Al in adults. The same treatment was repeated in four weeks and if necessary again in eight weeks. Most of the patients had suffered from repeated sore throat, 90 per cent being free of this complaint after treatment.

H. C. OCHSNER, M.D.

TUBERCULOSIS (DIAGNOSIS)

Is Bronchoscopy Indicated in Tuberculosis? Louis H. Clerf. *Jour. Am. Med. Assn.*, July 11, 1931, XCVII, 87-90.

With the general acceptance of bronchoscopy as an invaluable aid in the diagnosis of obscure pulmonary lesions and in the treatment of abscess in the lung, and bronchiectasis, the question is often asked, "Is bronchoscopy indicated in tuberculosis?"

In the treatment of uncomplicated pulmonary tuberculosis, bronchoscopy is not indi-

sition, at full inspiration, with the child in the recumbent position. In the lateral projection the patient is placed on the left side, with the arms back of the body and the chest thrown forward, so as to bring the anterior mediastinum well forward.

On roentgenograms the enlarged thymic gland will appear as an enlargement of the shadow from the base of the heart upward, with this shadow slightly overlapping the base of the heart, and extending symmetrically to either side of the spine, the upper limits being just below the clavicles. When the lateral enlargements are from one and a half to twice the width of the bodies of the third and fourth dorsal vertebræ, the thymus gland may be safely considered enlarged. The lateral borders of an enlarged thymus are smooth and sharply defined. In the differential diagnosis a submerged thyroid has its base above, narrowing below and merging with the thickening in the neck. In tuberculous mediastinal glandular enlargements, the shadow is denser, the edges are convex, and it is widest near the root of the lungs. The lateral enlargement is of less importance than thickening in the antero-posterior dimension, for it is this latter type of enlargement which is more apt to cause pressure on the mediastinal structures. Therefore, the lateral view not only gives the exact thickness of the gland but also the relation of the gland to the trachea, and information regarding compression or distortion of the trachea.

While some cases show evidence of an enlarged thymus on roentgenograms, and demonstrate no symptoms clinically, the author believes that under normal conditions there may be no pressure on the respiratory structures. However, what may happen in case of respiratory diseases must be considered, for the gland is known to enlarge during respiratory effort. This group of symptomless thymic enlargement cases comprises, undoubtedly, those which have not undergone accidental involution from disease, those in which the rate of chest growth has not kept pace with the thymus, as well as those with glands considered potentially a menace. An infant presenting an enlarged thymus with symptoms should have

radiation treatment, whereas an infant presenting an enlarged thymus without symptoms need not have irradiation unless an operative procedure with general anesthesia is contemplated.

The author's technic for the treatment of an enlarged thymic gland is as follows: 85 K.V., 4 ma.; filter of 4 mm. aluminum; focal skin distance of 10 inches; 1 to 2 minutes; two ports of entry. This treatment is repeated in from four to seven days. Two treatments are given and then roentgenograms of the chest are made to determine the amount of reduction of the gland. These findings, with the clinical symptoms, determine whether another application is necessary.

J. N. ANÉ, M.D.

The Thymus Gland in Infancy. C. S. Raue and C. C. Fischer. *Jour. Am. Inst. Homeop.*, June, 1931, XXIV, 545-552.

The authors review the history of the thymus gland in medical literature and discuss the symptomatology, diagnosis, and treatment of enlargement of this organ.

Sudden death in connection with the presence of an enlarged thymus was noted as early as the eighteenth century. About a hundred years ago, Kopp noted the relationship of the thymus gland to laryngospasm, and coined the phrase "thymic asthma" to designate this condition. In 1889, in his monograph, Paltaur expressed the opinion that thymic enlargement was a manifestation of a constitutional disorder in which thymus hypertrophy, general lymphatic hyperplasia, enlargement of the spleen, hypertrophy of the tonsils, and hypoplasia of the circulatory system were usually associated. This syndrome is known as "status lymphaticus." Pathologists, however, do not accept the theory that there is any connection between thymus hyperplasia and the so-called status lymphaticus.

The thymus attains its maximum development at the time of puberty. After this time it gradually undergoes a process of involution. It is situated in the superior portion of the anterior mediastinum, and normally extends

downward as far as the fourth costal cartilage. The normal weight of the gland varies with the age and weight of the child.

The symptoms usually attributed to enlargement of the thymus gland in infants are cough, dyspnea, cyanosis, and stridor. These result from pressure of the gland on the surrounding structures, such as the trachea and recurrent laryngeal nerve. Examination of these infants reveals substernal dullness and a palpable mass in the suprasternal notch. The value of the X-ray diagnosis of enlarged thymus has been discussed by many writers. The authors believe that correlation of the clinical findings with the X-ray evidence is necessary for a definite diagnosis.

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H. C. OCHSNER, M.D.

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In the treatment of uncomplicated pulmonary tuberculosis, bronchoscopy is not indi-

cated. Its value in tuberculosis is limited largely to diagnosis, although certain cases may be benefited by treatment. Symptoms unexplained by routine methods were, in individual cases quoted, cleared up by bronchoscopy.

Unsuspected pulmonary tuberculosis in pulmonary abscess, suspected bronchial foreign body, and asthma were discovered. Tuberculosis of the tracheal or bronchial walls is exceedingly rare, one case being reported as found by bronchoscopy. Hemoptysis is not uncommon in cancer of the bronchus and in bronchiectasis. The occurrence of hemoptysis contributes more often to an erroneous diagnosis of tuberculosis than any other sign or symptom. Obscure hemoptysis should be an indication for bronchoscopy.

C. G. SUTHERLAND, M.D.

A Case of Chronic Miliary Pulmonary Tuberculosis. M.-E. Meyers-Palgen. *Jour. Belge Radiol.*, 1930, XIX, 41, 42. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 273.

The author examined a 50-year-old man in whom pneumoconiosis could be definitely excluded. In the radiograph there were countless miliary shadows extending over both lung fields. There was no clinical evidence of activity. The author concludes that, as a result of an exceptional resistance of the patient's organism, the entrance of tubercle bacilli into the circulatory channels was prevented.

H. C. OCHSNER, M.D.

Hilar Dance, Silent Deviation of the Trachea, and Inhibition of the Right Phrenic Nerve in a Case of Pulmonary Tuberculosis. Alejandro A. Raimondi, Ramón Pardal, and Egidio S. Mazzei. *Prensa Med. Argentina*, June 10, 1931, XVIII, 4-11.

The authors present this case of pulmonary tuberculosis because of the lesson it teaches. A man, 38 years old, without any symptoms whatsoever, had a sudden hemoptysis. Physi-

cal and sputum examinations showed tuberculosis. The radiograph was interesting in that it revealed the following: (1) A retractile tuberculous sclerosis of the superior lobe of the right lung, with silent deviation of the trachea; (2) inhibition of the right phrenic nerve, as shown by paralysis of the right diaphragm, and (3) hilar dance—also known as hilar pulsation. These three findings were seen on many radiographs.

The hilar dance was studied by taking very rapid films and comparing them over millimeter paper. The authors attribute the hilar dance to an arterial pulsation at the hilum. Pezzi and Silingardi were the first to describe this phenomenon and attributed it to insufficiency of the pulmonary valve, while Miranda Gallino and the authors attributed it to sclerosis of the vessels associated with pulmonary hypertension. This phenomenon is of importance, because many of the hilar shadows frequently attributed erroneously to adenopathy are essentially vascular shadows.

N. G. GONZALEZ, M.D.

TUBERCULOSIS (THERAPY)

The Carbion Treatment in Pulmonary Tuberculosis. Rodolfo A. Vaccarezza and Francisco Martínez. *Semana Méd.*, Dec. 18, 1930, XXXVII, 1853-1877.

Carbion is a suspension of very fine particles of charcoal contained in a solution of calcium chloride. From 0.2 to 1 c.c. is injected intravenously, and the patient is put to bed until the reaction subsides. This is repeated every ten days, the dose varying according to the tolerance of the patient, and is continued for from six to eight months. X-ray films are taken all along.

Ten cases treated by the authors gave the following clinical and radiological results: seven grew worse; three had hemoptysis and other complications during the treatment; one showed no change, and two improved. The authors conclude that any similar substance either does not affect the patient or is injurious to him.

N. G. GONZALEZ, M.D.

TUMORS (DIAGNOSIS)

Tumors of the Duodenal Bulb and Their Roentgenologic Diagnosis. I. G. Brdiczka. *Röntgenpraxis*, July 15, 1931, III, 625-629.

Carcinomas of the duodenum are rare. They are supposed to originate from heterotopic gastric mucosa or from the epithelium of the duodenal papilla. Myomas, fibromyomas, and fibrosarcomas have been found in the duodenal bulb; the occurrence of lipomas, tuberculomas, and hemangiomas has also been described. Three cases with tumors of the duodenal bulb are presented.

The first case had a large filling defect in the pyloric region and was diagnosed roentgenologically as a pyloric carcinoma. Exploration showed a large, fixed, inoperable tumor in the antrum of the stomach. At autopsy, a large ulcerating carcinoma was found in the duodenal cap, which infiltrated the entire wall of it. The incorrect roentgenologic diagnosis is explainable by compression of the antrum by the large tumor originating in the duodenum just above the pylorus.

The second case showed a large filling defect in the greater curvature side of the duodenal cap, which apparently corresponded to a palpable tumor. The mass was fixed to the duodenal bulb. At operation, a well circumscribed tumor was removed, which originated from the wall of the duodenal cap. Microscopic examination showed it to be a fibromyoma. Roentgenologically, a diagnosis between a tumor originating in the duodenum and one only fixed to the duodenum could not be made.

The third case showed several round filling defects, the size of a hazelnut, in the duodenal cap. These defects were very plain when external pressure was applied. A polyposis or multiple myomas were mainly considered, but a polypoid carcinoma could not be excluded.

It is in most cases possible to decide if a tumor leading to a deformity of the duodenal bulb is extrinsic or intrinsic. A definite differential diagnosis between benign and malignant tumors cannot be made roentgenologically.

H. W. HERKE, M.D.

Neuroma of the Mediastinum. Juan José Beretervide, Juan Mariano Fazio, and Juan B. Cardenau. *Prensa Med. Argentina*, June 10, 1931, XVIII, 41-46.

Herein the authors present an interesting case of a large neuroma of the posterior mediastinum in a man 39 years old. In 1923, when first seen, his symptoms were chronic cough, with expectoration of blood-tinged sputum, and, under the right breast, a severe pain which would be present for a few days and then disappear for months, only to recur again. He continued this way until 1928, when he had a very severe attack of pain. Physical examination revealed a mass in the right lung, a radiograph confirming the findings. A diagnosis of hydatid cyst was made and an operation performed. On finding a solid mass, nothing was removed.

Two years later, a second radiograph was made, and the mass was larger than it had previously been, and presented a typical picture of neuroma of the mediastinum as described by Leuk—oval in shape, homogeneous, unilateral, the mass implanted over the posterior mediastinum. With these findings and by exclusion, the authors decided on the diagnosis of ganglioneuroma of the posterior mediastinum.

N. G. GONZALEZ, M.D.

TUMORS (THERAPY)

Adenoma of the Bronchus. R. Kramer. *Ann. Otol., Rhinol. and Laryngol.*, September, 1930, XXXIX, 689-695. (Reprinted by permission from *Cancer Review*, 1931, VI, 323.)

The author found only five cases in the available literature, and adds two of his own. Bronchial adenoma arises in the ducts of the mucous glands, which should be removed endoscopically, or treated by radium implantation or diathermocoagulation or a combination of these methods.

F. CAVERS, D.Sc., M.R.C.S.

Chondrosarcoma of the Tibia of a Guinea Pig, Following Roentgen Irradiation. M. Lüdin. *Schweiz. med. Wchnschr.*, 1930. I

162. Abstracted in Zentralbl. f. d. ges. Radiol., Sept. 19, 1930, IX, 249.

After daily irradiation over a period of months, there developed in the tibia of a guinea pig a thickening of the cortex, with an accompanying joint contracture. The radiograph demonstrated a high grade destructive process involving the bone tissue. Microscopic section showed the picture of chondrosarcoma.

H. C. OCHSNER, M.D.

The Roentgen Treatment of Mediastinal Tumors. A. U. Desjardins. Röntgenpraxis, July 15, 1931, III, 657-665.

The mediastinal tumors offer many difficulties in diagnosis and therapy. A roentgen examination can demonstrate the extent but not the microscopic character of such lesions. A biopsy is of great help when the tumor has metastasized into palpable lymph nodes. Irradiation therapy can furnish very valuable assistance in the differential diagnosis of mediastinal tumors. If they consist mostly of lymphatic cells, they will regress rapidly. Mediastinal tumors of other nature (carcinomas, sarcomas, except lymphosarcomas) are much more resistant to rays. This different behavior differentiates the first group (lymphoblastomas) very easily. Only inflammatory processes might react similarly.

The prognosis in the group of mediastinal tumors, which includes Hodgkin's disease, lymphatic leukemia, and lymphosarcoma, is still hopeless in practically all cases. The average duration of life without systematic treatment is about two and one-half years. An intelligent course of treatment usually leads to considerable improvement over some months, or even years. Dyspnea, cough, congestion, dilatation of the superficial veins, and hydrothorax often disappear after roentgen irradiation, and the general condition of the patient improves correspondingly, the rapidity of improvement being characteristic of these tumors. The results of the treatment depend on the extent, the duration, and the localization of the disease. Some advanced cases can be benefited considerably. If the disease is dis-

covered in an early stage, the chances of controlling it for a longer time are considerably better.

The case of a 27-year-old woman is described, being diagnosed as Hodgkin's disease, in 1921 (biopsy). She had X-ray treatments at that time. In 1927, a recurrence took place, which, however, reacted favorably again to irradiation. At present, the patient is symptomless.

Irradiation therapy in epithelial new-growths in the mediastinum shows much slower and not so lasting results.

H. W. HEFKE, M.D.

Calcification of a Suprasellar Tumor Causing Fröhlich's Syndrome which had been Irradiated Eighteen Years Previously. Angelo Santoro. Archivio di Radiologia, March and April, 1931, VII, 185-192.

The author reports a case of Fröhlich's syndrome in a patient with a suprasellar tumor. X-ray treatment over a period of eighteen years resulted in calcification of the tumor and marked remission of symptoms. The author emphasizes the value of roentgenotherapy in this disease.

E. T. LEDDY, M.D.

The Weight Curve as a Prognostic Sign in the Treatment of Malignant Tumors. Adolf Zuppinger. Röntgenpraxis, July 15, 1931, III, 665-669.

Examination and the critical evaluation of the subjective symptoms of the patient give a fair picture of the condition of a patient with a malignant tumor. The weight curve is of great value as a fairly dependable objective criterion. During the time of the protracted fractionated irradiation, the weight decreases generally, depending on the initial general condition and the severity of the reaction. Especially in cases in which the pharynx is in the course of the rays, the loss of weight is often very marked (radio-epithelitis), from 5 to 10 kilograms not being unusual. In favorable cases the weight increases rapidly after the reaction has subsided until it reaches the

initial point and rises from there gradually to about the normal level of the patient. If the tumor has not been destroyed completely, the weight level at admission is usually not reached again; renewed activity is plainly seen on the curve by a decrease. If distant metastases are present, the weight increases for a while, but afterwards gradually drops.

Several histories with corresponding weight curves are given to illustrate the value of observing and charting the weight. The curve represents, especially in patients with malignant tumors, fairly accurately and easily the general condition of the patient and is of great help for the prognosis. Of course, one must remember that heavy work, intercurrent diseases, psychic influences, etc., may change the weight curve independent of the course of the malignant disease.

H. W. HEFKE, M.D.

ULCERS (ETIOLOGY)

The Etiology of Gastric and Duodenal Ulcers: A Large Section Histologic Study of Local Blood Vessel Changes in Post-mortem Specimens (Preliminary Report). C. Bryant Schutz. *Jour. Am. Med. Assn.*, June 27, 1931, XCVI, 2182-2185.

The experimental evidence in most theories concerning the etiology of gastric and duodenal ulcers agrees in one fundamental respect: *e.g.*, the direct cause of ulcer is arterial obstruction.

From the histologic standpoint this theory of arterial obstruction has met considerable objection. A study was made of thirty fresh autopsy specimens of ulcer. In every one of the thirty specimens arterial obstructive lesions were found in the ulcer region. Obstruction of an artery was not found in any of the more normal portions of the stomach and duodenum.

The author's conclusions were as follows: (1) Ulcers of the stomach and duodenum are the direct result of infarction, due to any disease or mechanism which causes arterial occlusion. (2) Once the ulcer is formed, its subsequent course is determined by secondary

arterial changes. (3) The ulcer progresses largely as a result of the formation of small infarcts produced by secondary closure of capillaries in the floor of the ulcer. (4) In the majority of patients with ulcer, lesions capable of producing emboli, evidence of obliterating arterial disease, or infarction are found in other organs of the body.

C. G. SUTHERLAND, M.D.

The Local Radiologic Signs of the Stages of Development of Duodenal Ulcer. Giuseppe Martinotti. *Minerva Medica*, 1931.

The duodenal bulb is that segment of the digestive tract between the pyloric ring and the descending portion of the duodenum. It presents a base, an apex (fixed in most of the cases), and four walls. The two lateral walls are improperly called the margins or curvatures. The bulb is the preferred location for the ulcer, which is, as a rule, single; multiple duodenal ulcers are very rare.

The purpose of this work is to describe the roentgenologic deformities of the duodenal bulb induced by ulcer, the X-ray symptomatology of duodenal ulcer varying according to its location and stage of development.

Location of the Duodenal Ulcer.—The author thinks that the designation of duodenal ulcer as an ulcer of the walls or of the curvature is insufficient; he proposes the following classification:

(1) Ulcer of the base: juxtapyloric, close to the pylorus.

(2) Ulcer of the base: parapyloric, at the periphery of the base.

(3) Ulcer of the middle portion of the walls: located in the middle or central portion of the anterior and posterior wall.

(4) Ulcer of the lateral portion of the walls: located in the middle and lateral portion of the anterior and posterior wall or in the middle portion of the margins.

(5) Ulcer of the distal portion of the walls.

There are three stages in the development of duodenal ulcer as observed roentgenographically: (1) The initial ulcer; (2) the ulcer with extensive areas of sclerosis and scarring, and (3) end-results of the sclerosis.

First Stage.—The X-ray sign is the *niche*. This has the shape of a nail-head or a star, if the ulcer is on an anterior or posterior wall, and a niche in profile, if it is on the lateral wall. The nail-head niche may show better when the bulb is empty. Sometimes the ulcer of the walls shows like a clear area in the shadow of the bulb, as if the niche contained air instead of barium. The niche of the lateral walls is very rare compared to those of the anterior and posterior walls.

The author does not think the swallow-tail niche of Akerlund reliable as a direct sign of ulcer, as it can be imitated by a localized hypotonus of a segment of the wall when the surrounding parts are sclerosed by secondary chronic infiltrating processes, due to periduodenitis. In this first stage the bulb is, as a rule, ectatic.

Second Stage.—The sclerosis of the wall, which has already begun in the first stage, becomes more severe and gives origin to characteristic deformities of the bulb.

The sclerotic retraction of the walls and the healing of the ulcer do not always go hand in hand. The second is difficult to follow, since it is not easy to say when the niche is definitely closed and the ulcer covered with epithelium. The sclerotic retraction of the walls can be seen by the X-ray after a certain period.

The consequences of the sclerosis are: Rigidity of the wall which carries the ulcer; disappearance of the angle between the wall and the base; gradual retraction of the most mobile and closest portion of the remaining walls towards the ulcerated area.

The X-ray Signs.—(1) Eccentricity of the bulb in relation to the pylorus—this sign has no value if it is alone, as it can be given by a congenital deformity or pericholecystic adhesions.

(2) Rigidity of the lesser curvature—compression of the bulb in this stage shows that the duodenal rugæ run toward a point on the lesser curvature where the ulcer is located.

(3) Formation of an incisura on the non-sclerosed wall. Some think that the notch is due to spasm, some to scarring.

(4) Formation of pouches. Following the deepening of the incisura there develop two

pouches on the opposite side of the ulcer. In the ulcer of the middle part of the wall, the two pouches have the same size and the bulb appears as cut in two. In the basal juxtapyloric ulcer and in the distal parietal ulcer there is only one chamber. The bulb takes the appearance of a torch in the first, of a funnel in the second. In this second stage the niche may persist as expression of the ulcer or of the scar.

Third Stage.—The sclerosis has gone beyond the territory of the ulcer and will change that part of the bulb into a narrow rigid canal. On the other hand, the pressure of the food tends to enlarge the chambers, which assume the appearance of pseudo-diverticula. In this third stage the author distinguishes six varieties of bulb:

(1) A rigid canal with diverticula (from the basal juxtapyloric ulcer).

(2) A rigid canal with only one basal diverticulum (from the basal parapyloric ulcer, the diverticulum being opposite the side of the ulcer).

(3) A rigid canal with two diverticula at the base, and symmetric, one on the right and one on the left (of the parietal ulcer in the middle portion).

(4) A rigid canal with two diverticula on the same side (from the parietal lateral ulcer of the middle portion).

(5) A very short rigid canal, wider towards the base (from the parietal distal ulcer).

(6) A rigid canal with multiple diverticula, symmetric or not.

Steps in the transition between the first and second stages exist; the most typical is the one which gives the appearance of a Mexican hat (*sombrero*)—the top is the niche and the wings are the basal chambers.

From the examination of the different forms of transition, one could say that the spastic incisura gradually blends into the permanent retraction of one of the walls. This explains why the deformity of the second stage cannot always be found by the surgeon.

The author believes that the direct signs of duodenal ulcer develop in definite sequence in keeping with the stage of the ulcer. He pro-

poses the following classification of the radiologic signs:

First Stage.—Initial ulcer with or without early sclerosis of the wall: (1) Niche of Haudek; (2) nail-head niche, and (3) star-like niche.

Second Stage.—Ulcer with definite areas of sclerosis: (1) Rigidity of the wall; (2) eccentricity of the bulb; (3) incisura, and (4) chambers.

Third Stage.—Results of sclerosis: Rigid canal with or without diverticula.

The signs are constant in the first and third stages, but are variable in the second stage when the niche has disappeared and the deformities are not yet firmly established.

These variable X-ray images are the result of the rapid passage of the opaque meal through the chambers of the bulb, and are secondary to the gastric hypermobility which is almost always present in this second stage. Often in the second stage one observes, at the beginning of the examination, a microbulb with a rapidly changing shape, due to the hypertonus and hyperkinesis of the bulb. After a while, however, the bulb increases in size and is completely filled, due to the hypotonus and hypokinesis which follow the previous state. Therefore, when a microbulb or one which changes shape very rapidly is observed, and there is doubt of this being the manifestation of an ulcer in the second stage, or a reflex spastic syndrome from diseased appendix or gall bladder, one must wait or give antispastic drugs until a completely filled bulb can be shown. This so-called spastic-ulcerative syndrome is an expression of the second stage of the ulcer, but without other co-existing signs is not of diagnostic value.

The author warns against the pseudo-bulb in which neighboring segments of the deformed bulb may take the appearance of a normal one, and cause the lesion to be overlooked.

E. T. LEDDY, M.D.

V. WITTING, M.D.

ULCERS (PERFORATING)

Closed Perforating Ulcer Manifesting Itself by Subhepatic Gas Bubble. Folke

Knutsson. *Acta Radiol.*, 1931, XII, Fasc. 2, pp. 157-163.

Free gas may be demonstrated under the diaphragm in over one-half of all cases of perforating, duodenal, or gastric ulcer. In a small percentage of additional cases a collection of gas occurs under the liver, while none is demonstrable above. Such a collection must be distinguished from normal meteoric gas in the digestive tract. This can be accomplished (1) when no other gas shadows are seen in the right hypochondrium or (2) when there is enough gas in the adjacent bowel to definitely establish it as outside the digestive tract. Two cases are described and the radiographs reproduced in which this sign is present. In one, the gas shadow was projected over the gall bladder in such a manner as to lead to the mistaken diagnosis of cholesterin stone.

M. J. GEYMAN, M.D.

ULTRA-VIOLET LIGHT

Ultra-violet Point Radiation in Production of Developmental Abnormalities in the Chick Embryo. Marie A. Hinrichs. *Proc. Soc. Exper. Biol. and Med.*, June, 1931, XXVIII, 1059, 1060.

The author exposed various regions of developing chick embryos to ultra-violet point radiation, the type of effect obtained depending on the dosage and the age of the embryo.

The results obtained when the developing eye was irradiated were as follows: (1) Inhibition of the rate of development as compared with the unirradiated eye; (2) killing of lens tissue; (3) stimulation of the rate of pigment formation in the optic cup. Short exposures of the fore-brain of a 2-day embryo produced lateral overgrowth on the exposed side. No such effect was obtained in the hind-brain. Longer exposures produced a coagulation of brain tissue.

Moderate exposures of the heart produced a slowing of the rate of beat and a loss of contractility of the exposed region on subsequent incubation. A 45-second exposure of the base of the aortic arches resulted in atrophy of the

exposed portions of the arches and of the portions of the body supplied by them. On the unirradiated side, the arches and the vessels were distended and larger than normal.

The developing tail and limb buds were relatively non-susceptible to moderate doses, but a 90-second exposure produced a coagulation of tissue in the hind limb of a 2-day chick.

J. N. ANÉ, M.D.

Influence of Ultra-violet Rays on the Vegetative Nervous System and Hypothesis on the Mechanism of Their General Action. Gastone Torelli. *Radiol. Medica*, October, 1930, XVII, 1156-1179.

Experiments performed on forty subjects have shown that the human body responds to ultra-violet rays by an increase in tone of the predominant neurovegetative system. In vagotonic subjects, this increase lasts from thirty to forty-five minutes, while sympathicotonic subjects present also a second phase characterized by an increase in vagotony.

These observations led the author to formulate the theory that ultra-violet rays, by penetrating as far as the surface of the derma, injure some of the cells by photo-electric action. The absorption of the products of disintegration and altered cellular metabolism into the blood stream would be influenced by a vagotonic reflection, caused by direct stimulation of the last ramifications of the sensitive nerves reached by ultra-violet radiation. This would result in a mild proteinic shock.

L. MARINELLI.

Ultra-violet Point Radiation in the Production of Arrhythmias in the Heart of the Chick Embryo. Marie A. Hinrichs and George Warrick. *Proc. Soc. Exper. Biol. and Med.*, June, 1931, XXVIII, 1057, 1058.

The hearts of twenty-six chick embryos were exposed to ultra-violet point radiation by the authors, who observed that in every case it was possible to modify the rate of beat or its rhythm, depending on the dosage used and

on the location of the point of the quartz rod on the heart. Tachycardia and bradycardia were observed in eleven cases, arrhythmias were produced in ten hearts, and the direction of the beat was completely reversed in five cases.

J. N. ANÉ, M.D.

NOT OTHERWISE CLASSIFIED

The Value of Fluoroscopy. Claude Moore. *Virginia Med. Monthly*, December, 1930, LVII, 576.

A comparison between European technic, which is 90 per cent fluoroscopy, and American technic, where fluoroscopy is becoming less and less popular, is made. It is the author's belief that American roentgenologists do not recognize the value of careful and routine fluoroscopy, the diagnostic possibilities of which are almost as unlimited as the diagnosis by means of films. Fluoroscopy reaches its greatest usefulness in gastro-intestinal disease, in which the opaque meal should be watched through the entire tract, though in many other conditions its value is apparently not recognized, or ignored.

W. W. WATKINS, M.D.

Ions of the Air as a Biologic and Therapeutic Factor. Carlos Heuser. *Semana Méd.*, Dec. 18, 1930, XXXVII, 1933, 1934.

This article is more or less based on the work of Dessauer, Happel, and Strassburger, who experimented for ten years on the ions of the air. They concluded that there were other factors, outside of climate, humidity, atmospheric pressure, etc., which acted on the functions of animals and plants, the most important of which were the ions in the air. They stated that all the elements composing the air were formed by ions which carried an electric charge.

Happel has proved in his experiments that the action of negative and positive ions is different, the former causing a feeling of malaise, the latter, stimulation. Furthermore,

he states that in rheumatic persons negative ions produce an improvement and sometimes a cure. Strassburger has been able to produce a decrease in blood pressure in hypertension cases. The author concludes that time will determine the adaptability of this method of treatment which at present is not well accepted.

N. G. GONZALEZ, M.D.

Notes on the Technic of X-ray Control in the Operating Room. Emanuel W. Benjamin. Jour. Urology, February, 1931, XXV, 165.

In from 25 to 50 per cent of the cases checked by the X-ray control film was there incomplete removal of renal calculi. These figures represent incomplete removal by skilled, competent surgeons. Both fragments and stones, measuring 1.5 cm. in diameter, had been overlooked. Particularly does this error occur in cases of multiple or dendritic calculi.

The present method of roentgen control is not infallible, yet is of a distinct advantage. Interpretation and differentiation play a major rôle. Blood clots, coagulated tissue fluids, and overlapping detached soft tissues may prove troublesome. The greatest single factor in the failure of this method is the incomplete mobilization of the kidney, so that the film does not completely cover the organ.

In 1929, Jaches designed and constructed a special small cassette measuring $3\frac{3}{4} \times 4\frac{3}{4}$ inches, with an aluminum cover, containing a double intensifying screen. The exposure time is reduced to one-tenth of what it was with the use of ordinary films. Clear, sharp pictures are obtained. The cassette is firm and does not buckle, and is easily and readily re-loaded. The films are read while wet before an illuminating box. The X-ray exposure is made in front of the patient, and the time is about half a second or less, at a distance of from 12 to 19 inches. Guide needles are inserted into the exposed organ by the surgeon. The loaded cassette is then dropped into a sterile rubber bag, the inside of which has been first carefully wiped dry, and the cassette is then tucked in behind the kidney,

great care being taken to cover that part of the kidney under suspicion. Either side of the cassette may be used against the kidney. The surgeon directly behind the patient aids the radiologist in guiding the X-ray beam. This procedure eliminates possible contamination of the operative field.

DAVIS H. PARDOLL, M.D.

Calcified Cysticerci in the Human Body. Josef Tóth. Röntgenpraxis, March 1, 1931, III, 229.

Calcified cysticerci in roentgenograms have been reported in a few instances. The picture is so characteristic that the diagnosis is easy. One finds multiple, spindle-like areas of calcification in muscles and subcutaneous tissue, the length of which is from 5 to 9 millimeters. Most cases are diagnosed only accidentally, as the patient has no clinical symptoms.

H. W. HEFKE, M.D.

The Value of X-ray Diagnosis in Medical-legal Cases. A. Howard Pirie. Brit. Med. Jour., Nov. 1, 1930, II, 722-724.

It requires an expert not only to make the roentgenogram, but also one to interpret it. It is important to have a thorough knowledge of the formation of callus. Certain bones, such as the tibia, femur, ulna, and radius, form much callus, while the bones of the skull usually show no callus after fracture.

Examples are cited of the rare epiphysis at the proximal end of the second metacarpal bone, and of the epiphysis which occurs at the outer end of the acromion, both of which may be mistaken for fracture. They are, however, bilateral.

The importance of knowing the rare bones of the foot and wrist in order to be able to differentiate them from fractured pieces is stressed. Such bones are the os trigonum, the os peroneum, the extranavicular, the tibiale externum and others.

In the perfect examination for fractured ribs, it is necessary to have three sets of

stereoscopies—one anteroposterior, one at half left, and one at half right position.

The fact that the patella may develop in several parts, simulating fracture, must be recognized—the normal anatomy and also the normal variations must be known.

The technic for routine examination of the skull for fracture is given as stereoscopic left, stereoscopic right, anteroposterior, post-anterior—six views in all. Fractures of the base of the skull are rarely seen by X-ray examination.

WALLACE D. MACKENZIE, M.D.

Phleboliths in the Spleen. Th. Bársony and O. Schütz. *Röntgenpraxis*, Jan. 15, 1931, III, 68.

Multiple small and round shadows of calcifications have been described fairly often in the spleen. Bársony considered them to be phleboliths; other authors, however, have expressed their doubt about this explanation and called them calcified miliary tubercles (Courtin, Duken, and Assmann). To clear this doubt, the authors examined 180 spleens roentgenologically from autopsy material and found calcium shadows in seven cases. In the spleens examined from patients under fifty years of age, no calcification could be found; of the seven positive cases, six belonged to the age group of sixty to seventy-five. The calcified nodes were examined microscopically and found to be phleboliths. The miliary calcification of the spleen, as found during the examination of patients, corresponds to the picture described above, and can best be explained by the occurrence of phleboliths.

H. W. HEFKE, M.D.

Susceptibility to Cancer. William J. Mayo. *Ann. Surg.*, January, 1931, XCIII, 16.

According to the author, investigation of the various theories of the causation of cancer shows that the one provocative agent which remains unchallenged is chronic irritation. He reviews briefly the illustrations commonly used to prove this point. He states

that Wilson, MacCarty, and Broders have enlightened us greatly with regard to histologic character of the cell in relation to malignancy. It is probable that the more severe forms of cancer and the development of cancer in certain tissues is due to increased susceptibility. Perhaps the development of cancer, as well as its degree of malignancy, is attributable to the diminished activity of immunizing processes rather than to the nature of the activating agent.

F. B. MANDEVILLE, M.D.

A Quantitative X-ray Analysis of the Structure of Potassium Dihydrogen Phosphate. J. West. *Ztschr. f. Krist.*, 1930, LXXIV, 306 (in English).

A quantitative study of KH_2PO_4 , based on ionization spectrometer measurements and powder photographs, yielded experimental atom F curves for K, P, and O. Parameters were determined directly by double Fourier analysis. The structure deduced agrees with that of Hendricks (*Chem. Abs.*, XXI, 3777) except that the PO_4 group is found to be tetrahedral and the K atoms are equidistant from the surrounding O atoms. Probable positions for the H atoms are suggested. A method of determining the extinction coefficient of single crystals of high symmetry is described.

CHEMICAL ABSTRACTS.

Electrology: The Rays of Death and the Rays of Peace. Carlos Heuser. *Semana Méd.*, May 14, 1931, XXXVII, 1334-1336.

The writer is looking forward to the future, basing his statements on the discoveries up to the present time. He believes that the rays of death will soon become a reality, and to prove his theory he presents some of his experiments. He has been working with short waves—from 8 to 10 meters—on animals, such as rats and rabbits, putting them at about 20 millimeters distance between the two poles, and finds that they die from rise in temperature. If the head of the animal is within the action of the rays, death occurs instantly. Men working on this type of experiment often

develop intense headaches, vomiting, insomnia, nervousness, and generalized pain. In women, it inhibits menstruation and produces endocrine disturbances. Dr. Schlihagen, of Jena, with whom the author has worked, believes that different wave lengths are applicable to different diseases; for instance, that of 16 meters for cancer cells, that of 8 meters for Koch's bacillus, that of 20 meters for general paralysis, and reports splendid results. He attributes this action to the following: (1) Rise in temperature, and (2) colloidal action and ionic movements in the cells. If such rays act in that manner, they can be applied in such a way that they can kill.

By the rays of peace, he means the immobilization of an army by means of distant rays. This is accomplished by means of aeroplanes causing explosion through short waves, rendering the men unconscious and causing severe headaches among them. The action and laws of cosmic rays are not known yet, but soon will be, this writer claims.

N. G. GONZALEZ, M.D.

A Treatment Lamp for Light Therapy: Kandem Arc Light Sun. W. Mathiesen. *Strahlentherapie*, 1930, XXXVIII, 361.

A new type of carbon arc light is described operating at from 110 to 120 volts between the carbons which are burning in a metal cylinder. Data on current characteristics, spectral emission, and on the erythema effect are also given.

ERNST A. POHLE, M.D., Ph.D.

Roentgen Examination of the Male Gonorrheal Urethra. Z. J. Rotstein and Z. V. Chaskina. *Röntgenpraxis*, Oct. 1, 1930, II, 885.

Roentgenography of the male urethra may be of considerable help in gonorrheal diseases or their sequels. The technic is simple. After emptying the bladder completely the patient lies on his back, slightly rotated towards the left. The right leg must be flexed and ab-

ducted. A 25 per cent sterile solution of sodium bromide is injected in the stretched urethra, and a roentgenogram taken during the injection. Twenty-two patients were thus examined. While the roentgen method is not necessary in all such cases, it helps to visualize the lesion and its extent, as well as the progress and result of treatment.

H. W. HEFKE, M.D.

Methods of Scientific High Frequency Treatment. H. Hübner. *Strahlentherapie*, 1930, XXXVIII, 785.

The author speaks in this article in defense of high frequency therapy which has been very much discredited by its use in quackery. He hopes that an objective and scientific study of the subject will lead to a rehabilitation of high frequency therapy in medicine.

ERNST A. POHLE, M.D., Ph.D.

Effective Fighting of Film Fires. A. Giebmanns. *Strahlentherapie*, 1930, XXXVIII, 196.

The author describes briefly a film filing cabinet in which a sprinkler system has been incorporated.

ERNST A. POHLE, M.D., Ph.D.

The Effect of Liver on Kopro- and Uroporphyrin. H. Schreus and C. Carrie. *Strahlentherapie*, 1931, XL, 340.

Urine of a patient suffering from porphyria was concentrated and ground liver was added to a certain amount of it. This mixture was prepared for spectroscopic examination. The method is described in detail. It appears that the property of normal liver to destroy koproporphyrin is limited and not very pronounced. The decomposition by a certain amount of liver is proportional to the time during which it is effective. There is a definite difference between the effect upon koproporphyrin and uroporphyrin. The destructive principle does not tolerate boiling. It is still effective at a temperature of 50 or 60°

centigrade. Liver extracts do not show any effect, while liver which has been placed in the digestive fluids of man still destroys porphyrinuria in the urine.

ERNST A. POHLE, M.D., Ph.D.

The Radiation Department of the Women's Clinic at the University of Munich. Friedrich Voltz. *Strahlentherapie*, 1930, XXXVII, 199.

The author discusses in detail the organization of the Radiation Therapy Department in the Döderlein Clinic at the University of Munich. The article is well illustrated and gives the reader a good idea of the excellent facilities available there for the treatment of malignant diseases.

ERNST A. POHLE, M.D., Ph.D.

Roentgen Cataract: Its Significance and Prevention. Max Cremer. *Strahlentherapie*, 1930, XXXVI, 732.

Since cataract has developed in patients following exposure to X-rays or radium in the region of the eye, the author has constructed a protective device of gold with a thin glass cover. It is shaped so that it can rest on the sclera without touching the cornea. The device was used in twenty-nine cases in which careful examination of the cornea by a cornea microscope did not reveal any erosions. A thickness of 1.3 mm. of gold corresponds to a lead protection of 2 centimeters.

ERNST A. POHLE, M.D., Ph.D.

Neurotrophic Disturbances of the Hand Associated with a Bite of a Cat or Colles' Fracture. Henry Turner. *Jour. Bone and Joint Surg.*, January, 1931, XIII, 161.

It is well known that occasionally Colles' fracture is followed by persistent pain, wasting and contracture of the soft parts, and marked decrease in the density of the bones of the forearm.

The author believes that when these unfavorable conditions occur they are the result of injury of the interosseous nerve. He de-

scribes three patients suffering from cat bites of the wrist. In two, the dorsal interosseous nerve seemed to be injured, and disability and marked bone rarefaction occurred similar to those seen in the type of Colles' fracture referred to above. In one, the nerve appeared to have escaped injury and in this case recovery was prompt and uneventful.

PAUL C. HODGES, M.D.

What should the Practical Physician Know Concerning the Physics and the Biology of Rays? Friedrich Voltz. *Münch. med. Wchnschr.*, Jan. 2, 1931, LXXVIII, 14-17; Jan. 9, 1931, LXXVIII, 61-64.

In setting down what he thinks the practical physician should know concerning the physical and biological characteristics of rays, the author gives a general discussion on the nature of rays, their origin—(a) natural and (b) artificial—and their effects. Specific phases of the subject, such as the importance of rays in practical medicine, will be discussed in later articles of this series, he adds.

The Radiometric Micro-analysis. Rudolf Ehrenberg. *Handbuch d. biologisch. Arbeitsmethoden*, 1930, XV, 1703.

The method which is described in this treatise aims to use the highly sensitive measurements of radio-activity for a micro-analysis of biologically important substances. Compared with other methods of micro-analysis, this one is rather simple, dependable, and void of subjective moments. If radio-active indicators (Thorium B, Thorium C, Radium D, and Radium E) are added to a salt of the element in question, which must be its isotope, a certain equilibrium between the element and its isotope takes place, which remains the same after any chemical changes. To the substance in question, the radio-active indicator is added. Precipitation must take place because the principle of the method is the distribution of the radio-active substance in the precipitate and the solution. The radio-activity can be measured by an electroscope or

electrometers. The special analytical methods for calcium, iron, potassium, sodium, sulphates, phosphates, carbonates, etc., are described in detail.

H. W. HEFKE, M.D.

The Dispersion of Light in Organic Bodies. J. Plotnikow. *Strahlentherapie*, 1931, XXXIX, 469.

This is a brief discussion of the dispersion of light in organic compounds and an attempt to apply the conclusions on the design of bathing suits. The principle is to permit a thorough irradiation of the entire body.

ERNST A. POHLE, M.D., Ph.D.

The Effects of X-rays on the Bone Marrow. L. Siciliano and C. Banci-Buonamici. *Archivio di Radiologia*, November-December, 1930, VI, 1108.

The authors studied the effects of X-rays on the bone marrow, both by a review of the literature and by studies carried out on animals. They applied doses ranging from a fraction of one to 18 H at varying intervals to different fields, and examined the bone marrow in smears and histologic preparations. Changes were found in that part of the bone marrow which was irradiated, and marked distant effects were noted in marrow that had been protected against radiation. The authors believe that an indirect effect is largely responsible for the changes noted in the treatment of blood diseases.

E. T. LEDDY, M.D.

The Value of X-ray Studies to the Patient. Editorial. *The Modern Hospital*, June, 1931, XXXVI, 92.

This is a discussion of the value of the X-ray in diagnosis. Not only must the radiologist be able to obtain clear films, but he must have the ability to interpret them and to attach to them a clinical significance. The

physician on the case frequently relies to such a great extent upon the X-ray report in making his diagnosis that the patient's life may depend upon the outcome.

There is a contention that much of mysticism and of the dramatic is attached to the X-ray specialist, and that, due to this, the public has been willing to consider an exorbitant fee as a necessity without questioning the reason for it. Every private X-ray laboratory should endeavor to render to the public the best possible service at the least possible cost.

Recent Observations Concerning X-ray Cataract in Man. Rohrschneider. *Ztschr. f. Augenheilk.*, December, 1930, LXXIII, 97.

X-ray cataract is described as a particular form of exogenic cataract. Comparison is made between it and other cataracts, especially glass-blower's cataract.

A More Accurate and More Extended Cosmic-ray Ionization-depth Curve, and the Present Evidence for Atom-building. Robert A. Millikan and G. Harvey Cameron. *Physical Rev.*, Feb. 1, 1931, XXXVII, 235.

The authors continued their studies on the relation between cosmic-ray ionization and depth in equivalent meters of water, in order (1) to give further proof of the theory that the cosmic rays have their origin in the formation of helium, oxygen, and silicon out of hydrogen; and (2) to confirm and extend the ionization-depth curve, as formerly reported, at both its upper and lower ends.

From their results, the authors present evidence that the absorption curve shows an unmistakable banded structure, that the strongest and most absorbable band of the cosmic radiation comes from the formation of helium, and that three more penetrating bands are due to the formation of the other abundant elements of the oxygen, silicon, and iron groups. There also seems to exist sufficient evidence that the cosmic rays enter the earth's atmosphere as photons. The theory of the four observed bands being due to the forma-

tion of these elements is consistent with the observed cosmic-ray curve, which was considerably extended and made more accurate. The ionization values were obtained and confirmed by measurements with a highly sensitive electrometer of special construction. They were made on top of Pike's Peak and at various depths of two lakes (down to 262.5 feet). The absorption coefficients obtained in this manner vary from 0.35 per meter of water at the top of Pike's Peak, to 0.028 at the lowest depth of the lake.

OTTO GLASSER, Ph.D.

Sirocco Studies in Naples. Otto Kestner. *Strahlentherapie*, 1931, XXXIX, 391.

The peculiar reactions of man to the sirocco induced the author to study its physiology. He found that the sky radiation during the presence of the sirocco is very great. The

blood pressure in the persons examined was definitely decreased and the air contained traces of nitric acid.

ERNST A. POHLE, M.D., Ph.D.

Radiological Examination as a Means of Diagnosis of Death. Mario Maino. *La Radiologia Medica*, May, 1930, XVII, 544.

Of the different radiological means by which death may be diagnosed, the study of circulatory movements is certainly the most reliable. The author reviews the literature on the subject and criticizes the different methods that have been used. He advises the injection of 1 c.c. of a 5 per cent solution of potassium iodide in the cephalic vein at the elbow. The persistency of the image of the vein after a reasonable time would unequivocally confirm a diagnosis of death.

L. MARINELLI.

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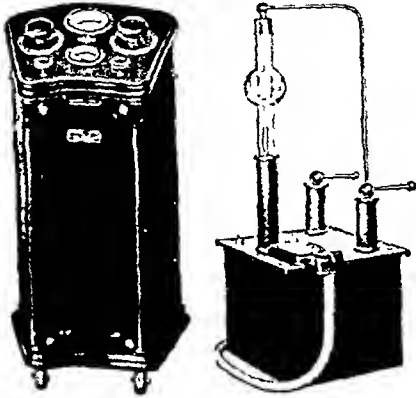
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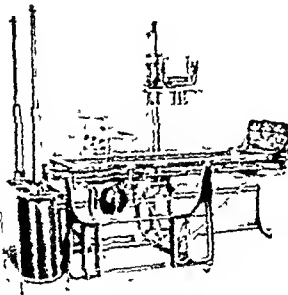
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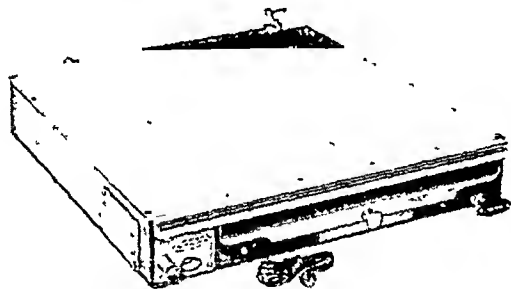
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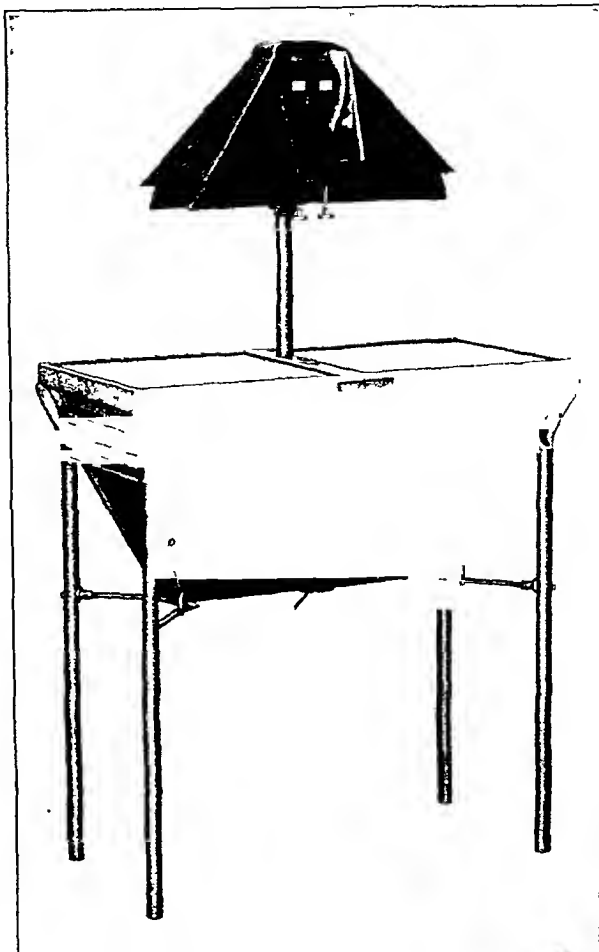
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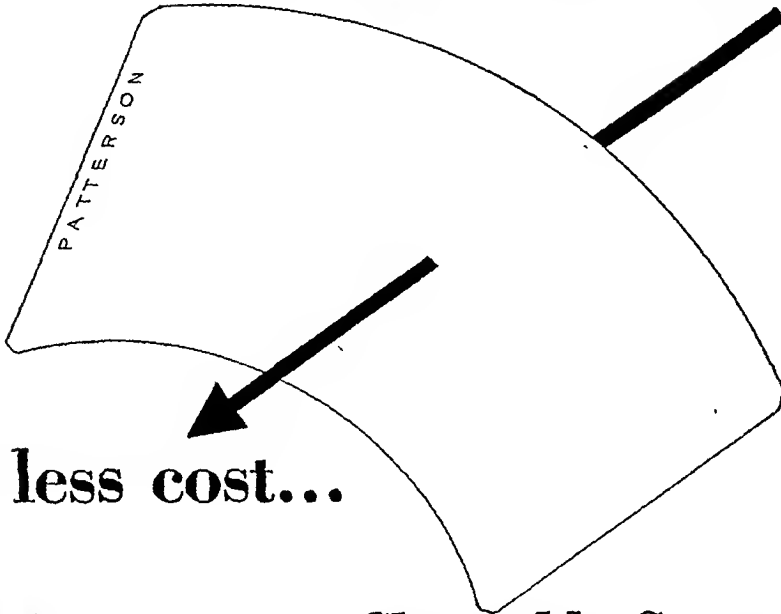
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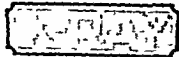
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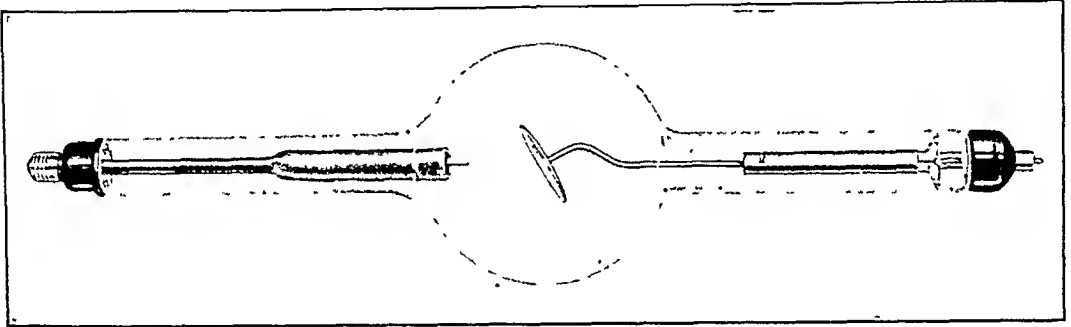
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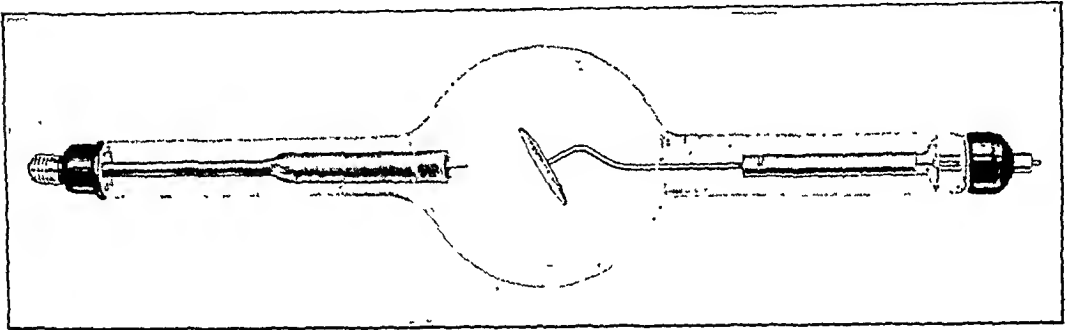
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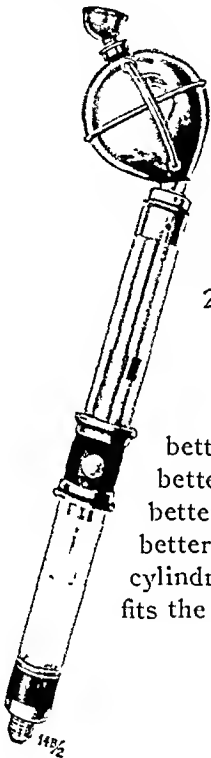
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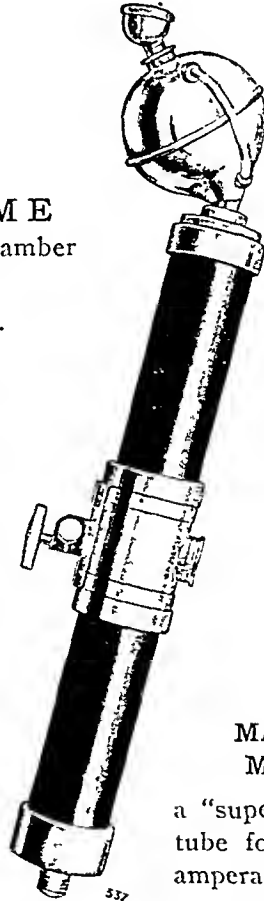


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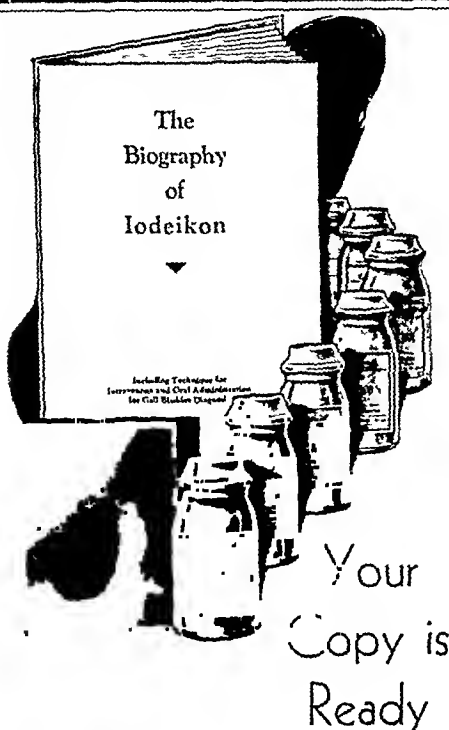
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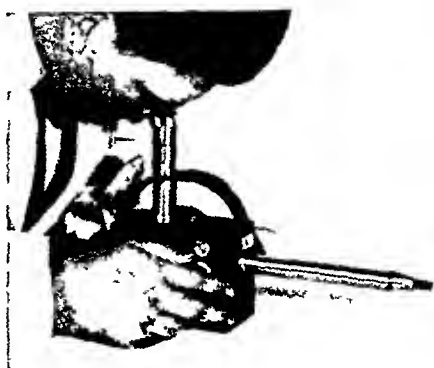
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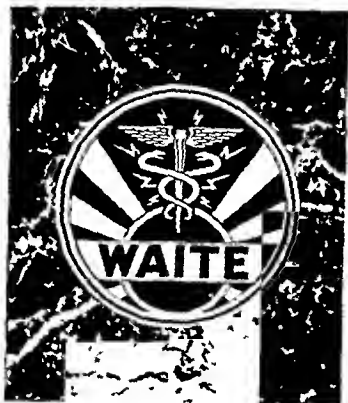
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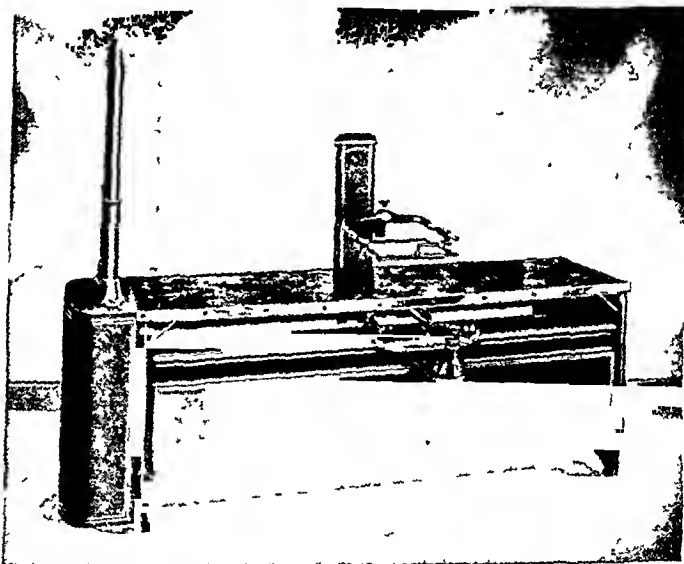
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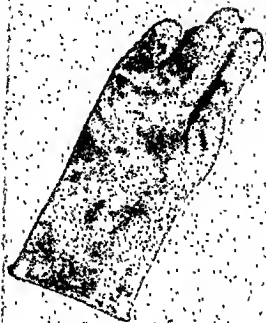
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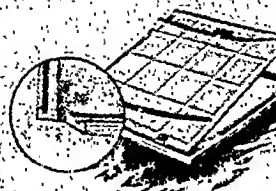
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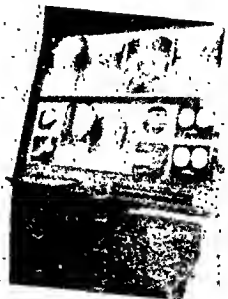
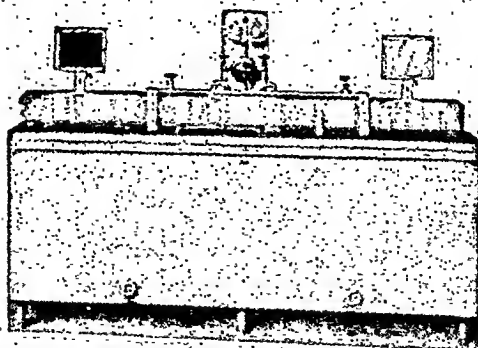
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